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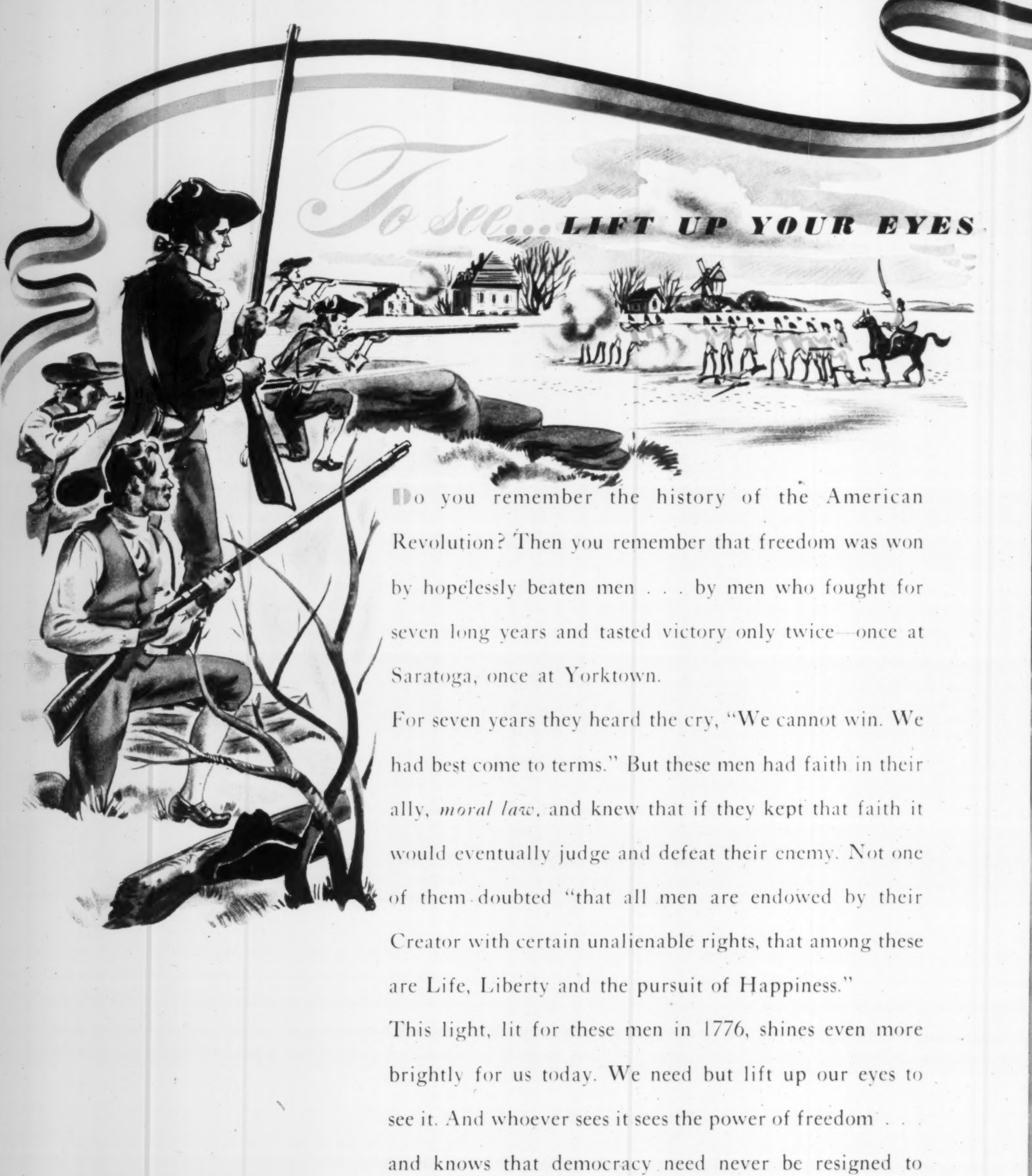
To see... LIFT UP YOUR EYES

Do you remember the history of the American Revolution? Then you remember that freedom was won by hopelessly beaten men . . . by men who fought for seven long years and tasted victory only twice—once at Saratoga, once at Yorktown.

For seven years they heard the cry, "We cannot win. We had best come to terms." But these men had faith in their ally, *moral law*, and knew that if they kept that faith it would eventually judge and defeat their enemy. Not one of them doubted "that all men are endowed by their Creator with certain unalienable rights, that among these are Life, Liberty and the pursuit of Happiness."

This light, lit for these men in 1776, shines even more brightly for us today. We need but lift up our eyes to see it. And whoever sees it sees the power of freedom . . . and knows that democracy need never be resigned to terms with the unmoral, the unjust.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

The Transportation of Tomorrow

Condensed from an Address Before the Baltimore Meeting of the Society

By Joseph B. Eastman

Chairman, Interstate Commerce Commission, Washington, D.C.

Within a lifetime, which I still see fit to regard as comparatively short, I have seen the birth and almost the death of one important form of transportation, the electric street railway; and the birth of two others, the automotive highway vehicle and the airplane—which, I am happy to say, show no signs whatever of approaching senility.

Basic Causes.~For the great acceleration that has taken place in the pace of transportation improvement, three things are primarily responsible:

1. The extent to which science, of which engineering is a vital part, has attained a position of commanding leadership in modern life. Certainly the scientist is playing a part in human affairs such as he never played in any previous era. The sad thing is that we seem so unable to confine the marvels of his work to good uses and that so many of them are now being put to uses which, if persisted in, seem to threaten the very basis of civilization.

2. Competition between different forms of transportation. This has become essentially a warfare between carriers of widely differing species. Whatever its demerits and dangers, clearly it operates as a very effective spur to enterprise and invention and exterminates any complacent satisfaction with things as they are. Particularly it compels attention to the needs and desires, and even the foibles, of the public which is being served.

3. The prevalence of international war. While at such a time the energies of science are diverted to destructive uses, their voltage is stepped up and there is always a residual by-product for constructive future use. Without doubt the World War did much to accelerate the development of both the airplane and the truck, and the present war is clearly renewing this acceleration in the field of air transportation.

A Glance Ahead.~Only a foolish man would undertake to predict what we shall see in the way of physical improvement of the means of transportation. Surely there will be many developments that no one now expects or even suspects. The most spectacular are likely to be in the field of air transportation. It is a safe bet that as a means of carrying passengers it will make great strides in safety, comfort, and dependability, to say nothing of speed, and that as a means of carrying property it will demonstrate its ability to become an important factor in the movement of at least high-grade package freight.

In highway transportation, the rapid improvement in the design of buses and trucks will of course continue. Probably trailers or semi-trailers will become as interchangeable as freight cars, particularly if state laws governing the sizes and weights of motor vehicles can be standardized, as I hope will prove possible. I expect, also, that there will be considerable improvement in the design and use of truck terminals as operations become better integrated.

Although an almost miraculous job has been done in the past twenty years in covering this country with a network of paved highways, an equally remarkable job is now under way in widening, straightening, and improving grades. As time goes on, we are likely to see the reservation of particular highways or lanes for truck travel. A vital problem is to provide free passage of traffic through or around the great metropolitan centers. At the same time joint consideration might be given under the financial auspices of the Government, to the problem of unifying and improving the railroad terminal facilities in these same metropolitan centers.

As to water transportation, I can predict only one thing. Evidently the cost of loading and unloading ships by old-time methods has become so high, as wages have increased and hours of labor have decreased, that attention is being concentrated on the use of mechanical means to improve these old-time methods. The Seatrain ships, which pick up loaded freight cars by crane, are one solution, but I suspect that there will be others.

Railroads and Research.~Turning to the railroads, within the past few years there have been more evidences of improvement in the design of passenger equipment than were seen for many previous years. This has been accompanied by like improvements in motive power and, to a lesser extent, in the design of freight equipment, particularly the running gear. But great as the improvements have been, the opportunities are far from exhausted.

With much advantage to themselves, the railroads could establish a centralized department for scientific and engineering research. They now have the benefit of research by individual equipment and supply companies, by individual railroads, and to some extent by universities, and such activities need not be abandoned. But if the direction and control of all such work could be centralized in a properly manned department of the railroad industry, better and more comprehensive results could be achieved at lower relative cost.

Things of Beauty.~There was a time when the railroads seemed to go on the principle that ugliness rather than beauty promotes utility. But now many new passenger cars and locomotives are things of real beauty; and the same may be said of the new street car, of many buses, and even of some trucks. In time I hope to see this trend reach the smaller railroad passenger stations. Of course it has reached the monumental stations, but parenthetically I venture the view that the cost of such lavish structures ought to be borne in part by the communities to whose civic pride they minister.

Beauty, not lavish but simple, is an element of utility. It is as important a factor as comfort in the satisfaction of the public that is served, and it attracts business. It also reacts favorably on employees, as many modern industrialists have demonstrated by test and experience.

All this is summed up in the fact that we are, for various reasons, in a period of rapid and accelerating development of the physical means of transportation, and we shall see many evidences of this in the future, some of which are now visible on the horizon while others are quite beyond our present ken.

Encouraging Labor Saving.~Many of these improvements will have the effect of saving labor. Of late years employees, particularly in the case of the railroads, have shown a tendency to resist changes that would result in a contraction in the number of employees and to seek agreements, also laws, to protect themselves. This tendency is entirely understandable, for declining railroad employment has brought much suffering to employees. That labor-saving devices or methods should not be adopted, I regard as a proposition which in the long run will clearly be harmful both to the transportation industry and to its employees; and of course the same is true in even greater degree of any agreements or laws that are designed to create work artificially. One way to increase the use of transportation service and the employment it provides is to reduce its cost, and most certainly not to maintain or increase that cost.

The best time for introducing labor-saving devices and methods is in a period of rising traffic, for then it can be done with little or no loss to employees. Contrariwise, the worst time is in a period of falling traffic and depression. In view of the present high and rising tide of traffic, caused by the national defense program, this is a phase of the matter to which railroad managements may well give thought.

Government Activities.~The rapid and accelerating pace of transportation improvement, and the consequent great increase in competition, have made the problem of Government control and supervision very different from what it once was. Regulation used to be regarded primarily as a means of holding in check what were termed "natural monopolies" and preventing them from preying on the public. In the field of transportation there is now comparatively little need for such regulation. The chief problem is one of keeping competition within reasonable bounds, in order that it may not be unduly destructive and undermine the ability of the carriers to give the service which the public should have.

Associated with this is the problem of preventing the advantages of competition from accruing more largely to those who have a great volume of traffic to offer than to those who are popularly known as the "little fellows." This problem is aggravated by the fact that the larger concerns now often have a wholly practicable alternative of providing their own transportation by the use of trucks, vessels, or sometimes pipe lines.

Engineering and Other Features.~From the engineering standpoint, the duties of the Interstate Commerce Commission in connection with the public safety are of interest. In the case of the railroads, the statutory provisions with respect to air brakes, automatic couplers, and other safety devices; the inspection of locomotive boilers; and the investigation of accidents proved their worth long ago. Now the Commission has even broader and more comprehensive powers with regard to the safe operation of motor carriers, and these powers extend to private carriers of property as well as to public carriers.

One very important matter with relation to transportation competition is not within the Commission's control. A very large part of our transportation facilities are publicly owned—highways, inland waterways, port terminals, harbor improvements, and airports. Therein lies a danger. To some extent the country is paying for its transportation service through taxes rather than through rates and fares. That is a question of public policy, but clearly the country ought to know all the facts and to have in mind the possible consequences.

New Leadership in Planning.~The rise of the new forms of transportation, the competitive warfare, and the present great pace of mechanical development, call for an attention on the part of Government beyond mere regulation. There is need for a constructive leadership, guidance, and planning from the point of view of the transportation system as a whole, and I know of no source from which this leadership can come except the Federal Government. Clearly there are certain things which each type of carrier can do better than any of the others, and the ideal system would be one which would utilize them all accordingly, emphasizing cooperation and coordination and avoiding definitely wasteful uses, but at the same time retaining a very considerable element of competition. Various developments within each branch of the transportation industry would be of much public advantage, but are not likely to be accomplished without Government help. Clearly, also, many of the Government's own activities in constructing transportation facilities are in great need of a centralized direction that will consider the transportation situation as a whole.

Such an agency as I am now suggesting, which might or might not take the form of a Department of Transportation, would be divorced from regulation of the kind which requires the determination of issues through quasi-judicial procedure, and would instead be what has been called a planning and promotional body. It would issue no orders, but it would be in constant touch with the transportation situation, watching developments, noting trends, discovering opportunities, and foreseeing dangers. Its influence would be exerted through voluntary cooperation and advice—to the carriers, to their employees, to shippers, and to all concerned in transportation.

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The Engineer and Defense Construction

Words of Praise as Well as Plain Talk from One Who Sees a Hard Fight Ahead

By Brehon B. Somervell, M. Am. Soc. C.E.

Brigadier General, U.S.A.; Assistant Chief of Staff in Charge of Supply, Washington, D.C.

Considering that, a year ago, the draft had not yet gone into effect and the great defense construction program had just begun, the progress thus far has been phenomenal. For their part in this effort, General Somervell has high praise for American civil engineers. But considering the situation as a whole, the General is not so optimistic. America must make a supreme effort to preserve the liberties for which she has already fought many battles. The stratosphere is the modern Armageddon, he says, and "it can happen here" unless we supply a "Niagara of aid" to our allies as well as to our own fighting forces.

This article has been prepared from the stirring address delivered by General Somervell at the Fall Meeting in Chicago, before the Society's joint luncheon with the Association of Commerce of Chicago, and has been brought up to date by the author.

The phenomenon of preparedness, little sensed in its entirety by the public, demonstrates in no uncertain terms the substantial results thus far achieved in the Army emergency construction program. Representing an investment in national defense of more than three billion dollars, it could never have been planned or put in place without the highly skilled and loyal services of the American civil engineer. More than a million and a half soldiers in the greatly enlarged American Army are newly housed in the finest quarters and training camps ever built for such purposes by any nation anywhere. Remember, as of October 1940, the draft had not yet gone into effect and the construction program had just begun.

Some time ago I made the statement that the story of the emergency construction program of 1940–1941 is the story of the man with the contract—the engineer, the architect, and the builder. They are doing this job together. They are partners of the Government and are indispensable to each other. All share the responsibility and burden of performance; all inherit the credit and the criticism alike, which are the inevitable aftermaths of public work ably and honestly done.

America arms, not only to protect herself and her liberties, but to assist all those who are resisting totalitarian aggression abroad. Americans who refuse to acknowledge that England and Russia are also fighting our battle seem to me to be either unwilling or unable to face stark realities and the brutal lessons of history repeating themselves before our eyes.

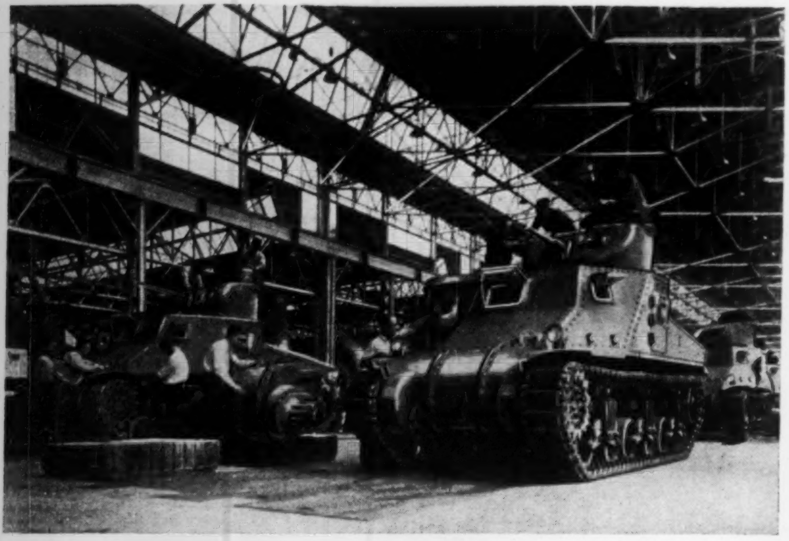
Two incompatible philosophies of life and government are locked in mortal combat. Either the principles of free democracy or those of martial dictatorship must survive. Hitler's timetable has always called for "America next" on his schedule, after finishing off England and Russia. His hand has been forced, somewhat regretfully on his part and certainly ahead of schedule, but we are now on that schedule. The free democracies must stand or fall together.

True, he has not yet crossed the 20-mile strip of English Channel in ships—but look at London, Liverpool, Coventry, and Glasgow. His Asiatic satellite has not yet attacked our mainland but look at what is happening to Hawaii, our Pacific bases, and the Philippines. They all offer tragic evidence that the stratosphere is the modern Field of Armageddon. So, it can happen here—that is, unless we everlastingly speed up the job of putting our house in order, hurry along the "Niagara of aid" that we have promised our compatriots abroad.

Within the last year a transformation has taken place in the face of America because of the activities of the various Government agencies engaged in the erection of defense structures. To the Construction Division, Office of the Quartermaster General, fell the responsibility of building, first, troop shelter for approximately a million and a half officers and men, and second, facilities for the manufacture or storage of arms, ammunition, equipment, and supplies.

The first responsibility has been discharged. The events of the last few days indicate great additional re-

Engineers, Working Overtime, Built Camps Like This, with All Utilities, in Record Time



Medium Tanks Roll Off an Assembly Line, on Site of Last Year's Cornfield

sponsibilities. In our first objective, all essential troop housing—in other words, what was necessary for the functioning of the camps and cantonments as efficient training centers—was in readiness by the end of June 1941. That statement, moreover, does not do the Army strict justice, because the camps were progressively occupied as accommodations became available. Soldiers and trainees entered some of them before the turn of the year 1941. Practically all were in active use months before the last nail was driven in the original program. At all periods of construction after March 15, there was actually a surplus capacity of around a quarter of a million beds over troop requirements.

For doing this job so quickly, the Army has been criticized by some who questioned the need of haste and the expense of construction. The events of the last few days now permit a complete answer to these complaints and that is simply this—the Army has been excellently housed on time and, we believe, in time. On the other hand, had the fault-finding been occasioned by failure to get the job done, no condemnation could have been more appropriately placed or too severe. As Gen. E. B. Gregory, the Quartermaster General, has said, "I can recall a time, not so far back, when few people were sufficiently interested in the Army to complain about it, and we didn't get enough money for anyone to worry about whether we were wasting it or not."

America never realized what a luxurious nation it had become until the Army had to go out and buy time for national defense building. Of all the critical items in the category of the construction industry, it is the one which bears the highest price-tag. It was a lucky thing for us that Hitler left some of it on the market. We bought and built it into factories and sturdy barracks for sturdy Americans, who have now been in training for many months, and the new American Army is ready for whatever may befall.

In an era of stress such as we are undergoing, it is more and more urgent that we keep our sense of proportion and perspective. First things should come first and should be evaluated on the basis of their importance.

In October 1940, when dirt began to fly in the emergency construction program, America had neither an army, strictly speaking, nor quarters in which to house and train one. A year later, we had both and had had them for several months. This is a significant achievement in so short a time. I shall not dwell upon difficulties overcome or records established in a building campaign which far overshadows in speed, extent, and quality that of the World War period, 1917–1918. This statement is no disparagement of that accomplishment. What I wish to emphasize is the fulfillment of the mandate by Congress, to lay the foundation for our entire national defense effort, by providing as rapidly as possible the necessary facilities for training and arming combat troops.

Subsidiary only to the raising of a modern, competent striking force, was the provision of ammunition and weapons for training and fighting purposes. Here again the element of time was paramount and still is. In this phase of the emergency construction program the nation had to start from scratch, in an effort to overtake a production competitor who had a seven-years' head start.

To date, he has dominated or overrun every nation in Europe save stubborn Great Britain. Nine nations have been defeated; others have laid down their arms without a blow. He has already invaded immense areas of Russia. In the last few days he has forced his Far Eastern, heavily armed and industrialized, satellite into the conflict. In all these countries he has added to his own productive capacity by enslaving the men and machinery of the industrialized sections he has conquered.

Making due allowance for sabotage by his rebellious, subjugated labor, it will take a lot of sweat, speed, and sacrifice on our part to catch up with these additional manufacturing facilities now turned against their rightful owners—a lot more than we as a nation have been willing to put out up to this time. But at least we now have a clear objective and are definitely on our way.

Many of the ordnance plants which constitute the great powder horn of the nation, like the camps and cantonments, the hospitals and harbor defenses, the storage depots, air facilities, and other projects launched a little over one year ago, are now going concerns. Many of them have been rushed to production far in advance of original expectation. They represent a vast new industry for the United States, one that has never hitherto existed in any magnitude commensurate with the size and needs of the nation, one which I hope we shall never again be stupid enough to let lapse into decay.

Besides those plants embraced in the first emergency construction program, a large number of new facilities are now in course of construction and projected. They are designed to produce an armament which can turn back the dictators in their strivings for world domination.

This extensive "Arsenal of Democracy," the units of which are widely dispersed throughout the interior of our nation, extending from the Great Lakes to the Gulf and

Sanitary Engineers Contribute To
Permanent Sewage Treatment Plant Under Construction for Large Army Reservation

from the Alleghenies and the Blue Ridge to the Rocky Mountains, will furnish the ammunition without which even the best-trained army, the most powerful guns, the fleetest airplanes, and the most formidable tanks are but useless items of military equipment. They have begun their function.

MATERIEL COMING FROM THE ASSEMBLY LINES

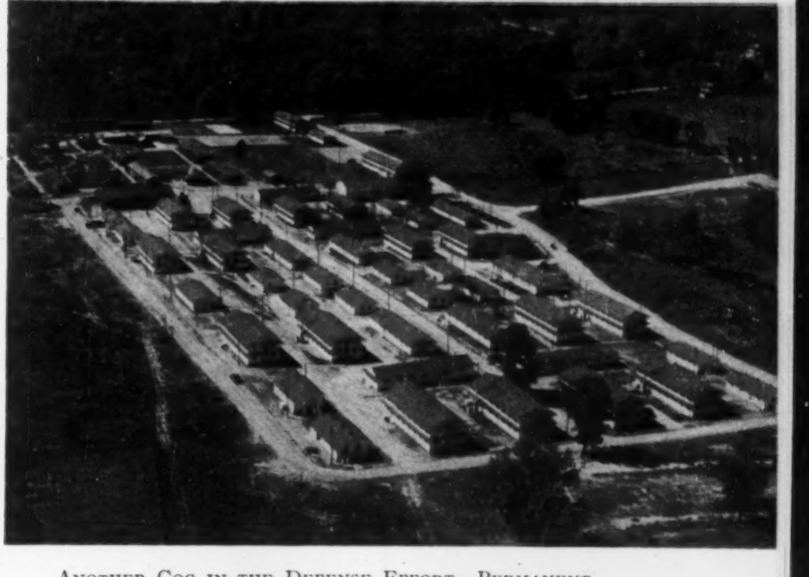
Powder is now coming from the assembly lines, TNT is in production, bag-loading operations have begun, and shells of various sizes are being loaded. Extraordinary measures were inaugurated by the Construction Division for bringing these facilities into operation. Planned and built according to the specifications laid down by the Ordnance Department of the Army, under whose supervision they will be operated, they represent but the first battery of assembly lines to be thrown into the war of production against those of the aggressor nations.

Little appreciated, outside construction and engineering circles, is the magnitude of the achievement in marshaling these huge manufacturing enterprises, most of them thousands of acres in extent, to the point where their operations could become effective, as a group, at such an early date. Not only with the products of these factories, but also with those of the great small-arms ammunition factories now being completed, are the troops now in training and combat being supplied in constantly increasing quantities. In 1942, approximately thirty more ordnance facilities of a nature similar to those already mentioned, will add the weight of their output to the spectacular volume of lead and steel produced by America's new powder horn. More will follow.

These details are cited to indicate the vital importance of the emergency construction program to the whole edifice of national defense. It is a fundamental operation, laying the solid flooring upon which the superstructure rests. Some of the figures are of astronomical proportions. America, I hope, will never again be forced to throw an untrained, ill-equipped soldier into battle or rely upon some ally for its very guns and ammunition. Many engineers know what that meant in the World War. Let us hope we are still in time.

There has never been any reluctance on the part of the Army to admit the deficiencies and errors of a construction program thrust upon it suddenly and encompassing the entire territorial extent of the nation. These admissions have been made with candor to Congress and its committees. Voluntary steps were long ago initiated for the correction of defects, well in advance of criticism. We must charge to human nature, I suppose, the tendency to look upon the publicizing of the Army's accomplishments as propaganda and the publication of its shortcomings as news. The best proof of the efficiency of the building program is to be found in the suitability of the facilities for housing and training troops and the adequacy of the factories for the production of munitions and equipment. On neither of these scores have I heard any real complaint. Let him who wishes compare the construction phase of our defense program with any other and he will find the comparison shows the credit balance heavily in favor of construction.

Highway Engineers Are Building Much-Needed Roads for the Defense Effort



Another Cog in the Defense Effort—Permanent Medical Unit Ready for Occupancy

CONSTRUCTION DIVISION FIRST IN THE FIELD

The first army to take the field in the present emergency was the Construction Division of the Quartermaster Corps. Its forces, at one time nearly 500,000 strong, constituted the shock troops of preparedness, the initial "task army" of the nationwide drive to get ready for war. It still numbers over 400,000, is being rapidly expanded to meet the necessities of our new objective, and is working in double shifts on production and storage facilities and four new division camps now under construction. This army can take over its new tasks without shock or delay. To its efficiency, to which many engineers have contributed, is due the rapidity with which the work has proceeded. This same efficiency promises even greater results for the future.

On every job, the engineer or architect-engineer has played a leading role. In the early days of the program, when adequate opportunity for planning was lacking, the engineer was often but a few steps ahead of the contractor. Despite the learned opinion of amateurs fortified with the advantages of hindsight, the engineering problems presented by both camp, plant, airfield, and other army construction were neither always simple nor always routine in their nature. They frequently taxed the ingenuity and resources of the most experienced. I am proud to say they have not been found wanting in either skill or zeal.

Ours has been a program that has amply tested the efficiency and scope of the American engineering profession. There is little that goes into any modern city in the way of engineering that is not to be found in the large cantonments; little in industrial engineering lacking in the plants. Hardly a phase of engineering—and here I speak of the profession in the broadest sense—is missing from the program. The miles of roads, or railroads, of water supply lines, the tanks and reservoirs, the purification plants, the sewage disposal plants, the dams in connection with such projects, the sewer lines, gas lines,

BUILT FOR SERVICE, THESE CAMP BUILDINGS HAVE A STEEL FRAME AND STEEL SASH WINDOWS

electric service lines, bridges, tunnels, and other structures present all the problems that are found in the book. New methods have been evolved to solve some not in the book.

The Construction Division has spared no effort to obtain the services of the most prominent members of the profession to staff its headquarters, its zone offices, and its projects. Scores have answered the call of their nation and have returned to duty as Reserve Officers. I cannot exaggerate the value of their services. Several Past-Presidents of the Society and many others of its most distinguished members have rendered notable service on the program.

VITAL CONTRIBUTION BEING MADE BY ENGINEERS

I wish I could mention the names of all these men, as an indication of the type of men from our ranks who have dropped their private and personal affairs to assist the Army in doing a good construction job. As in the World War, when the ability and patriotism of the engineers were challenged, they are again today contributing vitally to the success of the national defense program. Their skill, their judgment, and their integrity are even more urgently needed in the months to come. The Atlantic picture which has grown darker day by day is now further blackened by the Pacific situation, intensifying the hazard to our own country and the need for increased speed in our preparedness program. The engineer must be depended upon more and more to streamline construction activities and develop new means of making progress. He is key man for all the other efforts.

He is today our chief reliance in future planning activities as he will be in making the plans a reality. With the funds placed at our disposal for this purpose, we have provided the layouts and plans for future camp construction, and are now well along on plans for the expansion of other facilities. We have thus obviated many of the handicaps that beset the early days of the first objective and can proceed rapidly on our future requirements.

As a result of the advance planning done on four large sites which are now under construction, work was in progress well before funds had been appropriated therefor, and the completion of these facilities will be immeasurably expedited. Two of these projects, one at Camp Gordon, near Augusta, Ga., and the other at Camp Crowder, near Neosho, Mo., are now being built under fixed-fee contracts; the others, at Camp Chaffee, near Fort Smith, Ark., and at Camp Cooke, near Santa Maria-Lompoc, Calif., are being built under unit-price contracts awarded after public bidding. The latter procedure would have been impossible on such large work had we not had the time and money for the preliminary planning and surveys.

Under the present contracts in force for the four new triangular division camps just mentioned, and those in prospect for the expansion of existing manufacturing plants and the construction of new ones, the activities of the Construction Division will approach or exceed the scope of the initial program launched last fall. The air corps facilities being provided by the Engineers are even greater than before.

The work is being prosecuted speedily. We know that the Nazis and their satellites mean business and time is short. We have been fortunate thus far in the leeway provided us by the heroic efforts of their enemies in Europe. I am not one who views the situation with optimism. My references to the progress made in the construction of essential facilities for the training function of the American Army are not for the purpose of painting a complacent picture of satisfactory progress. We have done a lot but not nearly enough; we have got more to do, a great deal more if we are not to end up by having to fight the world alone and unaided.

That is the inevitable prospect before us, as I see it. This is no time for either quibbling or quisling. It is a time for Americans to be for America and not to sell the Army and the nation short by preaching the "other fellow's" gospel. I for one believe the country faces the hour of greatest peril in its history. A grim, deadly, merciless, brutal period of blood and toil, sacrifice and struggle, in my opinion, is ahead of us.

This may sound like plain talk but I mean it that way. The Construction Division has not been building camps and powder factories for fun. The Corps of Engineers has not been building air bases and military works for exercise. The Defense Plant Corporation has not been financing industrial facilities for the benefit of manufacturers. The Navy has not established island bases for shore resorts or been building battleships for excursion boats. The Army and Navy have been planning for keeps. Our past efforts, however, may be called fun, exercise, shore resorts, and excursion boats in comparison with the grim tasks ahead. Our objective is "Victory." Our means to attain the objective are "National Unity and National Solidarity." The electrifying events of the last few weeks indicate that we have the latter. We look confidently to the future. We expect and know that we have the full assistance of the American Engineer—and there is no better.

MECHANIZATION SERVES THE ARMY IN MORE WAYS THAN ONE

Camp Life at Shasta

A Live and Vigorous Community Grows Up "on the Job"

By Viola P. May

Wife of a Member of the Society on the Engineering Staff of Pacific Constructors, Inc., Shasta Dam, Calif.

To the construction man, home is where his wife and children are. On location this will mean anywhere from a trailer under the live oaks of "de low country" to a modern camp with electric stoves and hot-water heaters such as are now being used at Shasta. Whether it be a cabin on the mountainside in the Smokies, near a good limestone spring, or a tent in the desert a hundred miles from the nearest grocery store, each camp has its own particular flavor. Witness Las Vegas on a Saturday night, or for that matter Tucumcari, or Norris, or Disney, or Mason City, or any of the Army and Navy defense construction camps all over the country. In this paper Mrs. May tells of her life in the contractors' camp at Shasta.

PEOPLE who live in one place a long time sink roots deep into the life of their community. We who follow the "construction game" sink roots that grip and grow quickly—like desert cacti—but transplant easily to another soil. In fact, we may be likened to a moving city, whose roots have rested for a time in many states, wherever man would harness, for future generations, the forces of nature. Just now, these roots are planted at Shasta Dam with such apparent permanence that onlookers scoff at the mere suggestion that four years from now the village (as camp is called) will be only a memory—the beautiful camp site covered with the wild growth of oak, manzanita, and poison oak that was pushed aside to give it birth.

Hardly had the government order to "go ahead" been issued, when people began to pour into Redding—some, oldtimers who had worked for Frank Crowe, general superintendent of Pacific Constructors, Inc., for "y'ars and y'ars"; others, who had jobs awaiting them; many the hangers-on that follow every construction job, waiting for a chance to get on. This sudden influx brought such an acute housing problem to Redding (where Government and Pacific Constructors' employees lived until their respective camps were built) that houses were impossible to find. I, who had hopelessly and unsuccessfully househunted, and finally resigned myself to a makeshift life in an auto court, read with grim humor and deep understanding an ad in the local paper: "Wanted: To rent, a house, furnished or unfurnished. We have a child and a dog, and refuse to part with either." Our rented double, consisting of two bedrooms furnished with beds only, tiny kitchenette, and shared shower, was so small it could have been placed in our previous living room and no one would have noticed. When we squeezed around the table to eat, we were packed so close we could scarcely move. The task of keeping in my own plate and avoiding the children's elbows seemed at times more than the food was worth.

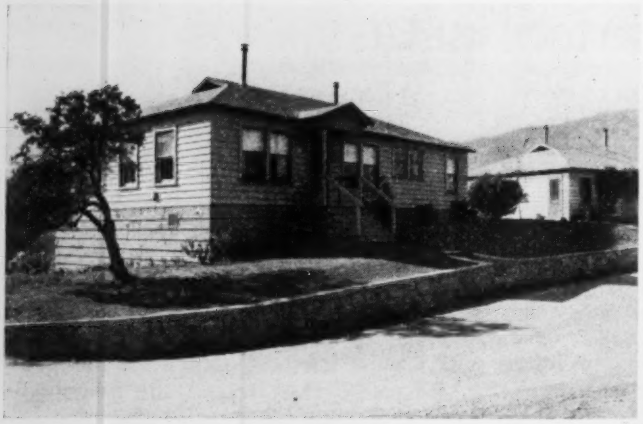
Meanwhile, in a once isolated mountain canyon, there arose with amazing rapidity the buildings that were to house a new community. First to be built were offices, shops, two large dormitories for construction workers, one dormitory for the office staff, a big mess hall serving excellent food, a general store to solve the immediate problems of food and simple necessities, a coffee shop for those who want a snack, a pool hall for amusement for the men, a fire station housing a modern fire truck, and a hospital completely equipped. Soon the hillsides were dotted with the 131 houses that made the village complete. Only the difficulty of access to camp over narrow, twisting mountain roads in cold rainy weather kept the women from hounding the carpenters to death with their desires to have their homes as nearly like those of their city cousins as possible. Our two, three, and five-room houses, for all their temporary aspects, are substantial affairs, with composition walls inside, pine wood outside. When the carpenters moved out of ours, we sanded, varnished, and waxed the floors, laid the linoleum, painted walls and woodwork. Those who wanted any change in plan, such as a bathtub instead of a shower, or sanitary tubs on the back porch, were allowed to have them by paying a little higher monthly rent. All houses were equipped with electric stoves and electric water heaters. For house heat, most of us installed oil stoves.

With our houses in livable order, we attacked the problem of landscaping the yards with the enthusiasm and vigor of those who intend to stay where they are for many years. Days spent in digging roots and stumps of manzanita and poison oak (with a week off, in my case, for doctoring a good itchy case of poison oak as a result) preceded the hauling of truckloads of dirt brought from the river to cover the hard clay soil. Lawns, flowers, even outdoor living rooms with barbecue pits soon gave camp the appearance of a beautiful mountain resort. Looking down on camp from the mountain top, I commented on its attractiveness one day, only to have a weary construction wife answer slyly, "Hm! Looks more like San Quentin to me—all those gray buildings, just alike in this isolated place, and even a guard at the gate to keep out people without passes!"

Houses were not available for all who worked on the job, so between Redding and the dam site arose the boom towns of Santa Claus, Project City, Summit City, Boomtown, and others. Prior to construction, perhaps a dozen people lived between Redding and the dam. Now it is estimated that about 11,000 live in these towns, which have sprung up "over night"—where four years ago were only pine trees and dense manzanita growth.

The inhabitants of "the village" are a composite group from various jobs. One street might well be named Parker Dam Avenue, for the same women who discussed the desert heat over their back fences now compare

Contractor's Camp at Shasta, Containing About 130 Separate Dwellings, Lies in the Hills Just South of Dam Construction



TRIM LAWNS, WHICH NEED WATERING TWICE A DAY, GIVE CAMP A NEAT APPEARANCE

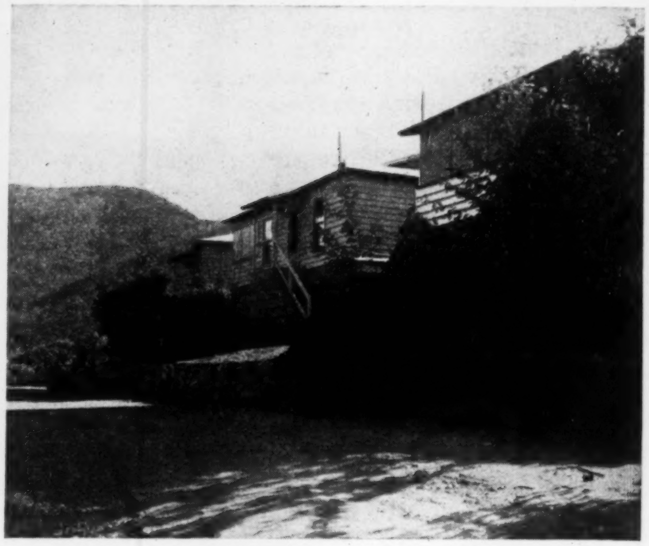
notes on their growing flowers and plants. Another street might be Boulder Dam Avenue, for a great many of the people who shared their joys and sorrows on that project are next-door neighbors here. Many of the younger group live up on the hill. Most of them considered this a perfect place to begin their families.

For variety and outside interest, there are the families who helped build the great aqueduct for the metropolitan cities of Southern California; those who watched Bonneville grow to maturity; those who worked on the Yuma Project; some from big jobs in the East and South—all working together with one big aim, the successful completion of Shasta Dam.

In spite of their "three-shift life" (for work never stops at Shasta Dam) these "construction stiffs" show a tendency to be quite normal people. There is no community house or club house in camp but there is much activity. There are the usual bridge clubs, and the usual number who don't care for cards. There are bowling teams for both men and women, who play in weekly competition with teams in Redding. There is a P.C.I. (Pacific Constructors, Inc.) baseball team, loyally supported by outspoken rooters from camp; there is a book club for the women, that meets bimonthly to discuss current events and new books. Gold panning is a fascinating game that young and old play at in spare time. A few find it a paying hobby. Fishing and hunting are sports that appeal to a big majority, and the country-side is ideal for these sports. There are Scout troops for boys, Parent-Teacher activities that keep parents busy. And now to these is added a busy group of Red Cross workers.

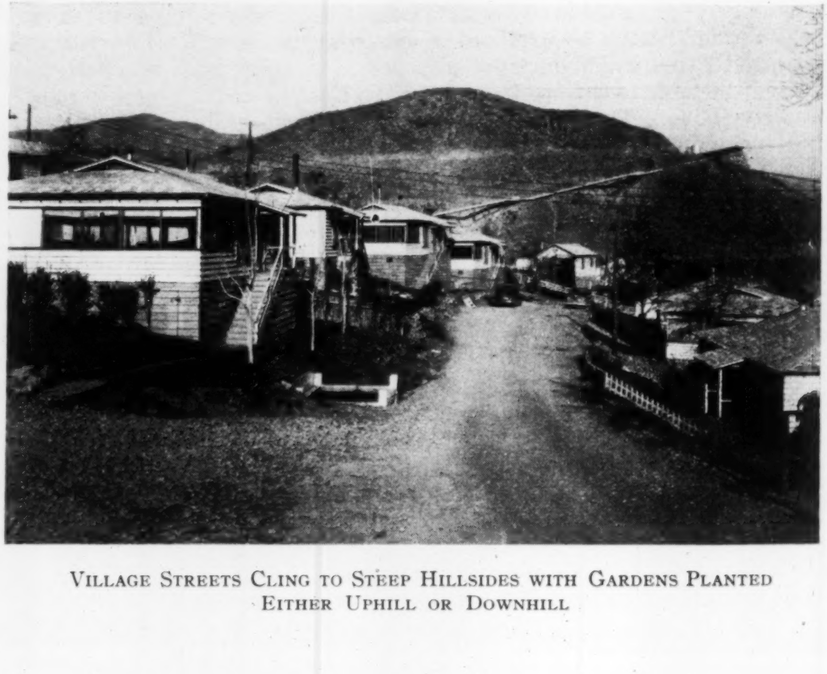
The problem of educating our children is a continuously perplexing one. Our company built a school some three miles from camp, at Summit City. No sooner were its hurriedly constructed rooms opened than children poured in, in overwhelming numbers. Soon the rough tables and backless benches that had to be used the first year were full. The teacher's desk would accommodate no more. The floors were congested with boys and girls who were delighted with the novelty, confusion, and fun of a new school. Two more rooms had to be built at once, and since then two additional rooms have been added and the outhouses have been replaced by modern plumbing. Today some 350 children attend a 10-teacher school, making this one of the largest rural grammar schools in the United States.

Children, as a group, enjoy camp life. My own wish we might always live here. Yards are small, sidewalks nil, and roads—though surfaced the first year—are steep and hilly, making skating and other city activities poor sport. Big signs at the entrance to the residential section warn visitors, "Drive slowly! Children playing in the streets!" The hills are ideal for hikes and wild flower hunts, and wild grape and blackberry picking in season add variety to such outings.



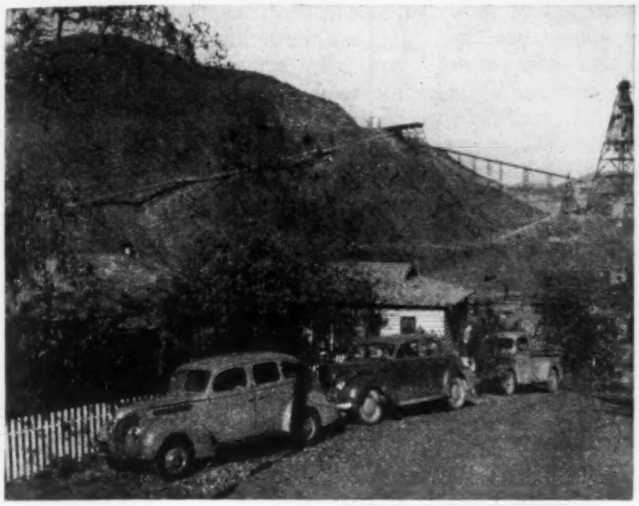
STONE WALLS AND JUDICIOUS PLANTINGS MAKE THE CAMP HOUSES LOOK LIKE A PERMANENT SETTLEMENT

Summers are so hot that almost every house has its homemade "desert cooler." This practical, though inelegant, device consists of a box full of excelsior kept continuously wet by the dripping from a water pipe above. The box stands just outside a sunny window, and an electric fan blows air through it into the house. Strange as it may seem, a cooler outside the living room window will make a difference of 15 or 20 degrees in the temperature inside on a very hot day. The principle on which it works is of course that heat from the atmosphere is absorbed for the vaporization of the water.



VILLAGE STREETS CLING TO STEEP HILLSIDES WITH GARDENS PLANTED EITHER UPHILL OR DOWNHILL

Climate regulates much of our activity—the heat of summer and the rain of winter. For winters here, in our experience, are just a series of rain and more rain. Those of us who came from desert country, where 2 inches a year was a lot of rain, felt we'd never "dry out" after living through 105 inches last year. Nor are these gentle apologetic rains! At times the deluge is so great that I can hardly see across the street, and winds drive the rain in a frenzy that turns the hilly streets into torrents.



Construction of Shasta Dam Can Be Seen from the Camp
Snow-Capped Mount Shasta Is in the Distance

These rains and floods are costly to the job and to the employees. Parents who must keep their children cooped indoors day after day feel the strain, but their troubles are as nothing compared to the men who must sit at home, watching the rain rob them of paycheck after paycheck—sometimes, as one housewife ruefully complained, owing the company money at the end of the week instead of having a paycheck come in.

In late winter and early spring, the Sacramento River rises to flood levels, licking hungrily at the high river banks and bridges until, its appetite satisfied, it subsides, leaving a tangled mass of debris behind.

Our first winter we had two snowstorms—thrilling, breathtaking events for adults as well as children.

Open Fireplaces with Stone Chimneys Were Extras Built by Hand After the Day's Work on the Dam

Outdoor Barbecue Pits Are Often Used in the Beautiful California Evenings

Few of us have ever lived in more interesting country. The scenery is magnificent. Near us, an easy day's outing, are Lassen National Park, Mt. Shasta, the Trinity Alps, and old ghost mining towns. From my front room windows I look out on the job, watch the cableways in operation, see the giant tower silhouetted against the sky, dwarfing snow-capped Mt. Shasta in the background. At night, camp from a distance looks like a fairyland, its shops and hillsides marked by thousands of sparkling lights.

Our camp doctor is a busy person. When the hospital (one of the best equipped and most efficiently staffed in Northern California) was built, we worried for fear it would be for men only. To our relief, we discovered that the doctor would serve their families too, and that the hospital would admit women for everything except maternity care (all babies are therefore born in Redding). So the doctor helped us through epidemics of measles, mumps, and chicken pox—diseases to which adults appeared to be almost as susceptible as children. Occasionally the shrill whistle of the siren gives us a start and we listen intently to count the toots, to see if it is a call for the fire department or the ambulance. Though every precaution possible is taken to safeguard the men on the job—signs everywhere, classes in first aid and safety training—there are a few who begin the job and do not live to see it finished.

The dangerous life we live is brought to our attention as we enter camp. A huge sign warns: "Drive slowly! Construction zone. Death is so permanent!"

Most of us shall not stay to see the finishing touches put on "our dam." Many of us may never return to view the dam and power plant in operation. Having built, we shall move on, to begin another project, to build another village, taking with us little but memories of friends and places. We shall leave behind us a magnificent monument to mark the spot where we spent happy years. And wherever we read or hear of Shasta Dam, we shall glow with pride and think, as the children put it, "That's the dam my daddy built!"

Better Highways for National Defense

Adequate Strategic Network and Access Roads Will Require Large Expenditures in Near Future

By L. I. HEWES, M. AM. SOC. C.E.

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ONE of the many lessons learned from the campaign of the German Army in Russia is that mobile mechanized forces need roads for both offense and defense. Roads for defense in the United States differ from those for civil use in that they need wider and better shoulders, heavier and wider bridges and underpasses, and surfaces capable of handling heavy high-speed mechanized units. In the older, more thickly populated sections, these military highways must be paralleled by civilian roads if both types of traffic are to operate at the same time. In addition access roads must be provided to all strategic points connecting defense industries, forts, and areas to be protected. This paper was originally delivered by Dr. Hewes before the Highway Division at the Society's Annual Convention in San Diego, Calif.

A COUNTRY of the size and population of the United States will, of course, require a correspondingly large mileage of highways for national defense. Defense highways are divided into two principal classes: (1) access roads to military, naval, and defense-production areas, and (2) the strategic network of about 78,000 miles.

Access roads are needed where new military or naval shore areas are detached from the existing road system, where the expansion of established military areas may overburden local roads, and where new plants for the production of defense arms and materials are causing congestion on adjoining highways. It has been found, in fact, that about 300 such military, naval, and defense areas require, for proper traffic service, new access highway construction totaling nearly 3,000 miles. On June 1, 1941, 308 areas had been certified as in need of access road construction, totaling 2,956 miles. At the present rate of defense construction, this need for access roads is due to become more acute.

Foreseeing the situation with respect to access roads, Congress in the Federal Highway Act of September 1940, provided for quick action for surveys, plans, specifications, estimates, and supervision of construction on projects properly certified for improvement from the standpoint of national defense. It authorized for such engineering purposes, in Section 18, the use of any regular funds already apportioned to the several states under Section 21 of the Federal Highway Act. Accordingly, after proper certification from defense authorities, the state highway departments have submitted projects for surveys and engineering under the regular procedure for federal aid. Such projects, to a total of 169, have been certified by the Secretaries of War and Navy and the defense production authority, and approved by the Public Roads Administration. In general, the funds are federal funds, not matched. The field investigation has been largely completed, and plans are well advanced. In fact, many plans have been completed, some work is already in progress, and a number of access road projects actually have been finished. This work has been accomplished partly by state highway departments and partly by WPA forces. A total of about $65,000,000, including state, county, WPA, and federal-aid funds, already has been allocated to the survey and construction of access roads. Most of these are outside the jurisdiction of the state highway departments. On May 31, a total of 1,671 miles remained unfinanced—estimated to cost $137,000,000—in 220 areas out of the 308 so far certified.

It should be observed that by order of the President, important preliminary engineering or reconnaissance for access roads was done during the season of 1940 by the Public Roads Administration after consultation with Post Commanders and Corps Area Commanders, and with the cooperation of the state highway engineers. The President, on June 21, 1940, advised Administrator Carmody of the Federal Works Agency to have the Public Roads Administration survey highway facilities from the viewpoint of national defense. So by the end of the 1940 season, there were on file in Washington reports by the Area Commanders on the access roads considered necessary to their military and naval establishments. These reports carried maps on a scale of 2 in. to the mile, and sketches of proposed construction and estimated cost. Thus they supplied the necessary background for the prompt beginning of surveys by the state highway departments late in the fall of 1940 and during 1941, under the Act of September 1940.

On February 1, 1941, Administrator Carmody transmitted to the President a report by the Commissioner of the Public Roads Administration. This report, "Highways for the National Defense," was based on the data obtained from the field examinations of 1940 and 1941. It was recognized that many of the access roads would be

SCENE OF A FATAL ACCIDENT CAUSED BY A WEAK SHOULDER ON 28° CURVE ON A NARROW HIGHWAY

Truck Shown Is in Approximate Position of Truck Which Turned Over When Driver Pulled Out to Avoid Oncoming Car of use to civil traffic. Some of them lie in groups around important areas, such as Norfolk, Va., and San Diego, Calif. Most of them are short. Some, on the other hand, have small civil use.

In some cases, through routes may themselves be classed as access roads. This happens where defense-production plants straddle important through routes that now are becoming inadequate, or where several military areas lie along through routes that need widening and the addition of traffic separation structures. In some cases, new links must be built around the reserved areas that close existing highways.

In the report of February 1, the Commissioner of Public Roads stated: "There should be appropriated to the Public Roads Administration not less than 150 million dollars for access roads to military and naval reservations and defense-industry sites. This sum should be available to pay all costs, including right of way, of roads in the vicinity of reservations and industrial sites when such roads are certified to the Federal Works Agency as essential by appropriate major defense agencies. It should also be made available to pay the cost of constructing new sections of highways, replacing existing highway connections broken by necessary closure at reservations and industrial sites." Following this report, bills were introduced into Congress, and the Defense Highway Act of 1941 was approved by the President on November 19.

Defense highways in the second category form what is known as the strategic network. This is composed of about 78,000 miles in a connected system of routes designated by the War Department (and Navy) as of principal importance for national defense. The net joins all important centers of defense industry and all military and naval concentration points. It overlays about one-third of the federal-aid highway system, and includes 30,000 miles previously designated by the Public Roads Administration as an inter-regional highway system in its report entitled "Toll Roads and Free Roads." This strategic net has been determined by conferences between the War Department and the Public Roads Administration with the full cooperation of the several state highway departments and also of the Navy Department.

Military Trucks Must Use Shoulder in Passing on Pavement of Inadequate Width (16 Ft)

The history of this strategic net goes back to the Federal Highway Act of 1921, when the Public Roads Administration inherited the work of the Council of National Defense. Thereafter the Public Roads Administration sought the advice of the War Department both on the location and character of military highway routes desirable for the federal-aid system and also on standards of design. The result was the War Department map of 1922, called the "Pershing Map." As regards design standards, it was decided that none were required superior to those for commercial traffic. Therefore the Public Roads Administration and the states have been guided by commercial standards, although these have imposed certain reciprocal obligations upon those responsible for the design of all types of heavy military equipment and ordnance.

Soft Grass-Grown Shoulder Gives Way Under Scout Car

In 1935, the so-called stage construction on the federal-aid system ended, and far-sighted planning for the eventual system began. Obvious defects still remained in the federal-aid system, both for civil and military use. Hence the War Department revised the "Pershing Map." The map was again revised in September 1939, and was thereafter known as the "Highway Map Showing Main Traffic Routes of Military Importance." At the suggestion of the War Department, the Public Roads Administration, with the important aid of the highway planning surveys, again studied the existing roads and submitted the results to the War Department. The revised map of May 15, 1941, resulted. It does not show a precise definition of location between major controlling points, but it does include all the interregional highway system. These main routes are intended to connect all important foci of actual or potential importance for defense.

Clearly, the strategic net is used much more by civil than by military traffic. The construction cost, therefore, is not a 100% federal obligation. For example, there are about 4,500,000 civilian trucks against possibly 300,000 army trucks, and there are 25,600,000 civilian motor cars. The Commissioner's report of February 1, with respect to the strategic network, states:

"To provide for the replacement of substandard bridges and the correction of other critical deficiencies of the strategic network at a desirable rate, a supplementary appropriation of not less than 100 million dollars is required. This appropriation should be prorated to the states on the existing federal-aid basis, and used solely for designated defense projects. It should be available to pay all legitimate costs of the projects on a somewhat higher basis of federal participation than the existing 50–50 basis, but otherwise should be expended under the provisions of the federal highway legislation.

"For the making of engineering surveys and plans for development of the strategic network, including the extensions of the system into and through municipalities and metropolitan areas, an appropriation of 12 million dollars is required, to be prorated to the states and matched by them on the existing federal-aid basis.

"To facilitate the accomplishment of all necessary improvements, the Federal Highway Act should be amended to (1) authorize addition to the federal-aid system of any roads conforming to the main lines of the strategic network, as designated by the War and Navy

UNSTABLE SHOULDERS FORCE ARMY CARS TO PARK WITH ONE WHEEL ON PAVEMENT

Resulting Overcrowding Is Dangerous

Departments; (2) make roads and bridges on auxiliary lines of the network eligible for improvement with federal-aid secondary roads funds; and (3) permit the use of federal-aid funds in payment of part of the cost of acquiring necessary rights of way and attendant property damage."

The Defense Highway Act of 1941 authorizes the following appropriations: $150,000,000 for access roads, $25,000,000 apportioned to the states under the Federal Highway Act formula for critical deficiencies of the strategic network, $25,000,000 for the same purpose for allocation by the Federal Works Administrator, $10,000,000 for the Commissioner of Public Roads to construct flight strips, and $10,000,000 for making advance engineering surveys and plans for development of the strategic network. This Act also, for projects built on the strategic network from previously apportioned funds, changes the ratio of federal participation from 50 to 75%. The act also carries provisions for off-street parking and participation in the cost of rights of way.

During 1941, state highway departments have been encouraged to use their federal-aid funds for defense highway projects on the strategic network. From July 1, 1940, to May 3, 1941, about 60% of the federal-aid funds allotted were for defense roads. The improvement of the strategic net is, of course, a long-time operation. The immediate objective is to eliminate serious weaknesses, particularly substandard bridges and surfaces not capable of supporting a 9,000-lb wheel load. Existing conditions are known mile by mile from the highway planning surveys and from the reconnaissance of 1940. Graphs of conditions on each route have been made. They show average daily traffic, types of surfacing, capacity of the weakest bridges in each mile, restricted vertical and horizontal clearances, minimum gross load of daily traffic and its frequency (as well as fatal accidents), restricted sight, excessive grades and curves, and bridges of less than 30,000-lb capacity. With a little practice, these graphs can be readily interpreted. The pressing weaknesses are narrow shoulders, weak surfaces, and substandard bridges.

Of the total of 18,000 bridges and underpasses on the strategic net, 2,436 are substandard. A standard bridge should carry two passing 15-ton trucks (H-15 loading), and in metropolitan areas the H-20 loading is recommended. The Commissioner's February 1 report carries wheel-load diagrams for Army vehicles, including tanks. Air Corps fuel tanks are of the heaviest type. The H-15 design will safely support military equipment other than heavy and medium tanks without special controls. Tanks of the 20 and 25-ton class must move in single file on the center line, at a spacing of 40 ft, but without speed limit. Heavy 55-ton tanks are safe if moving in single file on the center line, spaced 50 ft apart, at a speed not exceeding 4 miles per hour.

Horizontal clearances should be widened to from 26 to 30 ft. Any bridges of less than 20-ft horizontal clearance need posting. Similarly, underpasses should be 30 ft, and preferably 40 to 44 ft wide. Any vertical clearances of less than $12^1/_2$ ft should be increased and new structures should have a 14-ft vertical clearance. On the rural strategic net, over 5,000 miles are surfaced for a width of less than 18 ft, and probably 14,000 will not support a 9,000-lb wheel on pneumatic tires. These items, next to bridges, are major defects. The Commissioner of Public Roads estimated that $458,000,000 was needed to eliminate such serious deficiencies.

Some other characteristics of the strategic net are of interest. For example, over 7,700 miles lie within cities. Over 19,000 miles carry 1,800 vehicles daily, and 18,600 miles have less than 600 vehicles. Such statistics have been carefully tabulated. The extreme of inadequacy cited is on a section of over a thousand miles of paved road less than 18 ft wide which is carrying over 1,800 vehicles daily.

Mechanized Army convoys already have demonstrated the need of wide shoulders, and in future, even civil traffic will require more widening of shoulders. Some states now prefer to construct wide shoulders at staggered intervals of about two miles. Some immediate widening is indicated on about 43,000 miles. For adequate improvement of the strategic net, the indicated first expenditure of $458,000,000 will have to be followed by like amounts for a series of years.

It is assumed that the two main categories of national defense highways—access roads and the strategic net—will be supplemented where necessity develops. For example, such supplementary mileages may be needed within military and naval reservations, on sections leading to isolated points of strategic importance along our coasts or borders, and in areas used for tactical maneuvers.

As previously noted, the Defence Highway Act of 1941 provided $10,000,000 for the construction of auxiliary and emergency airplane landing fields or flight strips adjacent to highways. This matter is now under investigation by the Public Roads Administration. A report by Col. Lacey V. Murrow to that Administration regarding similar conditions in England already has been filed. It is to be observed in this connection that the determination of the required thickness for base and top courses of runways for heavy bombers still requires study and experiment.

PARKED CONVOY FORCES CIVILIAN CAR INTO OPPOSITE LANE BECAUSE OF POOR SHOULDERS

The photographs which illustrate this article were taken by J. F. Cameron, Highway Engineer, Public Roads Administration, Federal Works Agency.

Foundations for Buildings

Settlement Problems Encountered in the Design of Spread Footings Frankly Discussed

By Jacob Feld, M. Am. Soc. C.E.
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THE search for a rational analysis of building foundations has been going on continuously since the days of Leonardo da Vinci. The complete and final answer is still in the future although the review and suggestions presented in this paper by Dr. Feld clarify some of the basic premises. Damage due to foundation settlement in monumental structures is often given more attention than the ever-prevalent settlement cracking and failures in small structures such as stores and dwellings. These latter failures, like the common cold, are disregarded because they are so frequent, but careful attention to the problem as outlined here can go a long way toward eliminating them.

MOST textbooks on foundations start with the equation $A = \frac{P}{S}$, that is, the area of footing needed equals the quotient of the load to be carried divided by the unit bearing value of the soil carrying the load.

Actually, the equation should read: The area of a footing required to comply with the limitation of a desired amount of settlement of the column carried, for a known distribution of loading on the base of the footing and for known elastic characteristics of the footing, approximately equals the quotient of the actual average load divided by the average bearing value of the soil for the case of a footing of the same shape and size, under the same loading, for a definite subsidence in the desired time period.

Since fully 90% of foundations for buildings are in the class of spread footings, this paper covers that subject alone. The other 10%, being chiefly pile foundations with a sprinkling of caissons, are outside the scope of this paper.

The purpose of a footing is to support a definite, assigned portion of a building. Since all footings will settle, that is, the load carried will cause a vertical displacement, the perfect design is that in which all footings are displaced equally, both horizontally and vertically.

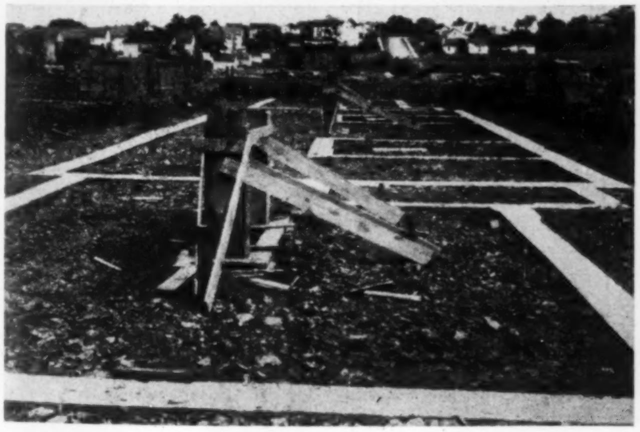
From the theory of elasticity and resilience of materials, methods have been developed for the design of timber, steel, concrete, and other masonry structures in the form of slabs, beams, plates, columns, and so forth. These methods of design, as far as footings are concerned, are perfectly safe although of doubtful economy. In any event, there are only very few cases on record where a footing failed structurally. In 1928 (*Engineering News-Record* for June 28 and November 8, 1928) a portion of the abandoned 42-year-old Chicago Club building, five stories high, dropped 16 ft. Investigation showed that a cast-iron column had punched through a dry-laid masonry footing for its full story length, into the soil beneath.

Since there are on record many cases of foundation failure, it must be concluded that the ground on which the footing rests is the cause of the trouble. The displacement due to the load carried can take one or many of the following forms:

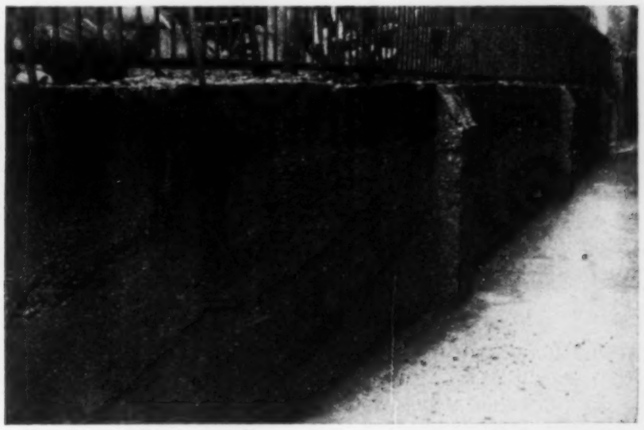
1. Compression of the footing material, elastically.
2. Deflection of the footing unit, elastically.
3. Compression of the soil directly below the footing, elastically.
4. Vertical yield of the soil directly below the footing because of horizontal transfer of stress with consequent horizontal strain, elastic and plastic, possibly not equally in all directions.
5. Vertical yield of the soil due to change in character of the soil, such as squeezing out of water content under pressure, change in volume at contact planes of different materials, change in chemical constituents of soil or rock.

If it is kept in mind that the last three of these movements may be caused not only by the loading of a particular footing but also by loadings on adjacent footings, and also that the loading at the bottom of a footing is not uniform over its entire area, then the complexity of the problem will be apparent. If the amount of the total movement is kept within the elastic range, either beginning with a zero load or beginning with a fixed consolidation, and if the distribution of pressure at the bottom of the footing is known within reasonable limits, then a complete solution of the design of a footing is possible.

The soil on which footings are built can vary from almost liquid clay or silt to hard rock. A load placed on any kind of footing on any material in this range must settle. That conclusion is only a restatement of the requirement that every action must have an equal and opposite reaction. The action is the load; the reaction is the internal stress built up in the earth or in the rock



Typical Wall Bearing Foundation, Where All Loads Are Carried on Strip Footings



Movement of Retaining Wall Due to Excessive Loading and Lack of Weep Holes

VERTICAL UNDERPINNING OF WALL, WITH THE NECESSARY LATERAL SUPPORT

by the induced strain, which is the settlement. If the strain is beyond the elastic limit, failure occurs by continuous increase in settlement, unless the soil changes in character as a result of the strain (change in volume).

Many data may be culled from the experiences accumulated by engineers and presented in engineering literature. It is my personal opinion, with respect to settlement, that:

1. In soft rock, hardpan, and dense glacial deposits, settlements of from $^1/_4$ to $^3/_8$ in. must be expected and will occur almost immediately under loads of 10 tons per sq ft.

2. In dry sands, a settlement of $^1/_2$ to $^3/_4$ in. must be expected and will occur almost immediately under loads from 3 to 4 tons per sq ft.

3. In wet sands, a settlement of $^1/_4$ to $^1/_2$ in. will occur immediately under loads of from 2 to 3 tons per sq ft, and will increase to $^3/_4$ in. in a period of months, especially if the sand is drained.

4. In dense clays, usually mixed with gravel or sand, settlements under loads of 3 to 4 tons per sq ft will be $^1/_2$ in. immediately and will increase to about 2 in. in a period of years.

5. In soft clays, settlements under 1 to 2 tons per sq ft will be 1 in. immediately and will increase to 3 in. in 3 years. There will be a continuous increase with time; values of 6 to 9 in. are not unusual.

6. In unconsolidated silts and muds, settlement amounts are unlimited.

These values are for individual footings of small area. The settlements under footings of large area in granular soil will not be uniform, chiefly because the base pressures are not uniform. The settlement of large areas in plastic soils will not be uniform because the base pressures are not uniform and the effect of plastic flow is much less in the interior of the areas. The total settlement of an entire structure will be increased by two factors:

1. Consolidation of the subsoil by the added load.

2. Effect of adjacent loads on the footing in question.

The method of computing the total vertical decrease in thickness of a soil structure due to added load, based on laboratory compression tests of undisturbed soil samples in laterally restrained apparatus, is now well established. Except for structures built on soft plastic clays and loose water-bearing silts, this factor may be disregarded.

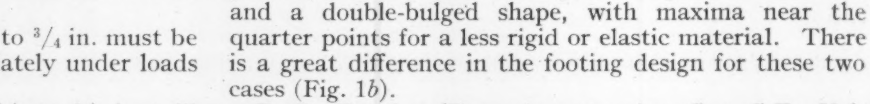
A more serious factor in the usual construction design is the effect of adjacent loads. F. Kögler (Harvard Soil Mechanics Conference, 1936, Vol. 3, page 66) describes the condition where, in buildings founded on clays, the interior footings settle more than those along the street lines. A related phenomenon is the upheaval of the bottom of an excavation due to the lateral pressure of the banks, causing a release of body density during construction.

D. E. Moran (*Journal* of the Franklin Institute) in 1925 expressed the common assumption up to that time that in granular materials the loading is uniformly disributed under a footing and then spreads in the form of a cone or pyramid. Kögler in 1936 stated that the base distribution must be assumed as either uniform, parabolic with zero load at the edges, or bell shaped with a constant minimum along the edges and a maximum under the center of the footing area (Fig. 1*a*).

A. E. Cummings (TRANSACTIONS, Am. Soc. C.E., Vol. 101, 1936, page 1072) states that the pressure distribution curve is a direct function of the elastic curve formed by the footing. There are two general cases, a parabolic distribution for a rigid footing on a dense sand, and a double-bulged shape, with maxima near the quarter points for a less rigid or elastic material. There is a great difference in the footing design for these two cases (Fig. 1*b*).

D. P. Krynine (TRANSACTIONS, Am. Soc. C.E., Vol. 103, 1938, page 827) states that bridge pier tests on gravel and theoretical considerations would show higher stresses at the edges for a rigid footing on a non-rigid earth mass. The non-uniformity of base pressures was shown by Fehr and Thomas in 1912–1914, in their tests at Pennsylvania State College, as well as by F. J. Converse in 1933 at the California Institute of Technology.

W. S. Housel (University of Michigan Research Bulletin No. 13, 1929) concludes that for equal settlement, the bearing value equals the area times the strength of the pressure bulb, plus the perimeter times the shear value of the soil. Unit bearing capacity for equal settlement varies with the size and shape, being greater for smaller areas and smaller for round areas. His formula is $P = Am + Sn$. If m and n are assumed constant for any one soil, two load tests on different areas are sufficient for a complete solution.

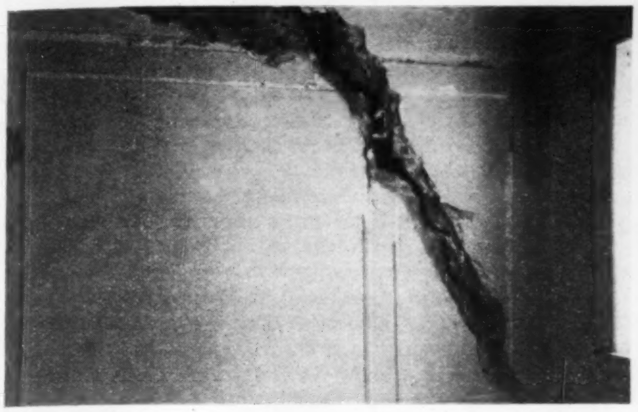


(*a*) KÖGLER'S ASSUMPTIONS (*b*) CUMMINGS' ASSUMPTIONS

FIG. 1. ASSUMED DISTRIBUTIONS OF BASE LOADING

S. D. Carothers (International Mathematical Congress, 1924), making deductions from the theory of elasticity, proves that for strip loads of infinite length and also for circular loaded areas, the same stress difference (vertical minus horizontal) results from a smaller unit load in the larger footing area.

In 1885, Boussinesq published a solution of the distribution of stress in an elastic material caused by a point load on a horizontal surface. The vertical stress at any point in the mass equals $\frac{3PZ^2}{2\pi R^2}$, where Z is the vertical depth, P is the load, and R is the radius vector, or the diagonal distance between load and point in the soil being studied.



Lateral Cracking Results from Eccentric Loading on Yielding Plastic Soil

In 1935, A. E. Cummings recommended that in place of a constant 3 in the numerator, a variable amount—from 3 for hard dry clays to 6 for sands—be used.

Kögler modified the Boussinesq distribution by means of an average straight line, somewhat steeper than the curve, with a somewhat larger maximum stress vertically below the load (Fig. 2*a*).

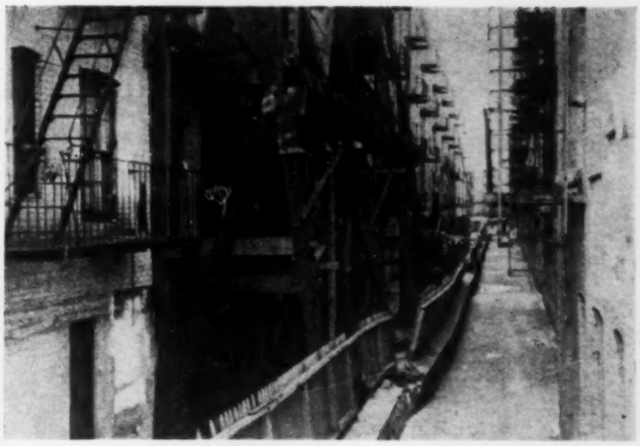
The distribution of load from a footing into the subsoil can be pictured by dividing the area into three types of affected zones, A, B, and C (Fig. 2*b*):

A. Circular shape or volume of permanent deformation, passing through the edges of the load and of depth t, the depth of permanent set.

B. The remainder of the area, in which there is elastic deformation.

C. Areas between the top of the ground and somewhat curved lines making angles of ϕ' with the verticals passing through the edges of the load, in which there is no effect.

Housel modifies this picture for the soil below the depth equal to the width of the loaded area by the assumption that the pressure is uniformly distributed over the width within 1:1 slope lines from the edges of the footing, or as an alternate, is uniformly distributed over the width of the footing and then decreases to zero at the intersection with a 1:2 slope line from the edge of the footing (Fig. 2*c*).



Movement of Wall and Building as a Result of Apparently Good Sand Foundations of Shallow Depth Sliding Along an Inclined Rock Stratum

The subject of pressure distribution evaluation has also been studied by D. M. Burmister, who has contributed a graphical method for summating pressure intensities from irregular shaped and multiple loads, by D. Krynine and by N. M. Newmark for elastic materials. Reports of full-scale settlement studies have been contributed by K. Terzaghi and G. P. Tschebotareff, as well as by many others.

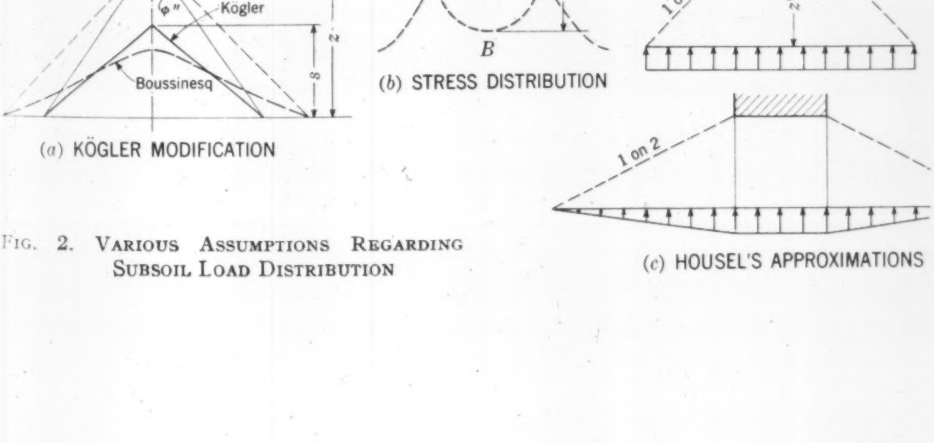
For the purpose of designing a footing or of estimating the total expected settlement of a structure, the distribution of pressure in the soil below the contact area is an important consideration only when soft layers are encountered which may fail under the combined stresses from various loads. For the design of the footing itself, the writer has felt that a uniform distribution is not always proper, except for rigid floating foundations.

The ground work has now been laid for a rational design of footings. Returning to the original formula, the load to be used for design must be at least the dead load including the weight of all fixed partitions, furniture, finishes, and so forth. However, it is very doubtful whether the live load has any effect on settlements in the usual type of buildings, but of course it must be considered in such structures as grandstands, where it may vary from zero to over 150 lb per sq ft during the minutes before and after a touchdown.

Where city building codes are enforced, the loads used in foundation design are usually fixed. Two requirements are very common:

1. Footings are to be designed to sustain full dead loads and a reduced summation of live loads on all floors, the percentage of reduction increasing with the number of stories, but seldom becoming over 50%, with the limitation of the listed maximum soil unit pressures for various classes of soils.

2. Footings are to be designed as in (1), but their areas are to be proportioned for equal soil pressure under



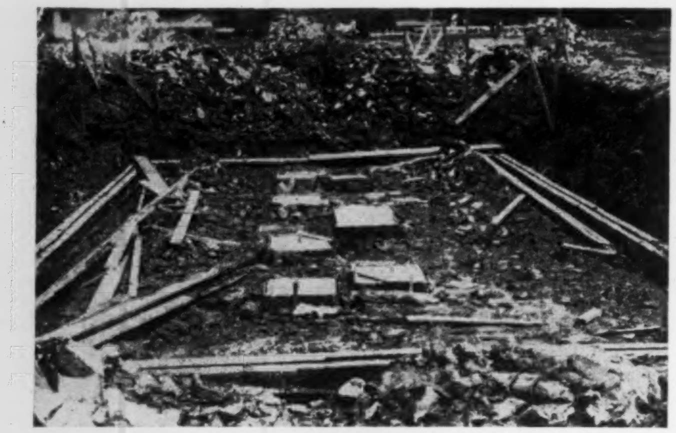
(*a*) KÖGLER MODIFICATION

(*b*) STRESS DISTRIBUTION

(*c*) HOUSEL'S APPROXIMATIONS

Fig. 2. Various Assumptions Regarding Subsoil Load Distribution

dead load only. In this method, unit base pressures under full dead load plus live load are greater for the interior footings than for the wall footings. And since wall footings are usually rectangular and, if at the street lines, on soil less affected by adjacent loads, the opposite condition would be more conducive to equal settlements.



SMALL HOUSE FOUNDATION IN SOFT CLAY WHERE LACK OF SOIL DRAINAGE WILL RESULT IN EXCESSIVE SETTLEMENT OF INTERIOR FOOTINGS

This latter requirement was in the New York Building Code until 1938. In the first method, since the computed live loads seldom (if ever) exist, the actual base pressures on the interior footings are less than those on the exterior footings.

The rigid solution of the design of a footing for a given unit load on the base is a function of the settlement and is many times indeterminate. As compared to a uniform distribution, the effect on the computed bending moment in a single loaded footing (whether square, round, or strip shape) may be large, but the effect on the computed shear, as well as on the unit shear and bond stresses in the concrete may be disregarded from the viewpoint of both safety and economy. In large footings, where the bending moment controls the design, as well as in combination footings of either the mat, cantilever, or combined type, the change in distribution may effect both safety and economy.

That the effect on safety is questionable can be concluded from the fact that many footings of this type have been constructed from designs based on the assumption of uniform distribution. The usual explanations as to why the concrete does not fail structurally are the surplus strength of the material (factor of safety) and the non-existent live loads included in the design. However, since unequal settlements may occur, even though the total base pressures may be less than computed, another explanation is necessary. It is found in the theory of "limit design," very similar in its fundamental idea to the theory of least work. In a closed system of forces and restraints, local failure cannot occur, because the continuity of the mass causes a transfer of load to the spots that can take it best.

In conclusion several practical considerations may be stated as guides in the design and construction of building foundations:

1. The base pressure is more uniform under the more rigid footings.
2. Non-uniform distribution may be disregarded in footings resting on soils having a bearing value of over 6,000 lb per sq ft.
3. On similar soils for the same loads per unit area, square footings settle more than rectangular footings.
4. On the same soils, for footings of the same shape, under the same average load intensity, the larger footing will settle more.
5. Footings on the outside of a building, not adjacent to other loads, will settle less than those affected by adjacent loads.
6. Footings will probably settle further when adjacent soil areas are loaded.
7. Bearing-value tests are only reliable when the exact conditions are duplicated.
8. Flexible footings may be designed for smaller bending moments than are given by the assumption of uniform distribution.
9. Footing failures are seldom structural failures.
10. Uniform building settlements can be obtained by taking into consideration:
    - *a*) Actual loadings to be expected.
    - *b*) Greater soil-bearing value of exterior locations.
    - *c*) Provision of slip joints for settlement of adjacent future structures.
    - *d*) Effect of difference in level of footings in close proximity.
    - *e*) Changes in portions of the soil area due to water, weathering, and vibration.
    - *f*) Difference in bearing value of differently shaped footings.
11. Maximum soil pressure under the center of a footing is no criterion of the expected settlement, because of the load distribution due to rigidity of footing.
12. Bearing pressures of soil and expected settlements deduced from load tests in the field or from laboratory tests on undisturbed samples have no value if the conditions of the actual construction work are not considered.
13. Exposure of soils during excavation may modify the soil structure and change all its characteristics.
14. All structures will settle, and provision must be made for the expected settlement by keeping them free of adjacent structures that have moved into a stable position.
15. Lateral resistance in soils must not be disturbed or reduced below that necessary to balance the lateral stresses resulting from the added loadings.

The problem, although a very old one, is far from completely solved. Much research work is now being carried on, both in the laboratory and in the field to determine more closely how settlements can be controlled and estimated. The cooperation of carefully trained observers of construction work and the correlation of actual with expected results are most important if data of practical usefulness to the designer are to be developed.

BREAK IN A WATER LINE MAY BE A CONTRIBUTORY CAUSE OF FOUNDATION SETTLEMENT

New Sanitary Sewage Facilities for San Diego

Acute Pollution Problem Was Caused by Sudden Population Increases Due to Defense Activities

By B. D. Phelps *and* R. C. Stockman

Respectively Assistant City Engineer and Assistant Engineer, San Diego, Calif.

A POPULATION increase in San Diego from 200,000 to nearly 300,000 in a single year has produced sanitary sewage disposal problems of the first order. National defense projects, aircraft factories, and services for all the armed branches are located here and are rapidly expanding. To care for this growth the old city utilities must be expanded correspondingly. In this paper, delivered before the Sanitary Engineering Division at the San Diego Meeting, Messrs. Phelps and Stockman tell of the financing, designing, and construction of sewage works intended to keep San Diego Bay from pollution even in the face of this unprecedented situation.

SAN DIEGO is situated on a beautiful land-locked harbor used by many U.S. Naval vessels and seaplanes as a home port. It is also an excellent recreational area. The city has had a steady growth up to this time but has been mainly residential—free from large manufacturing plants of all kinds. However, it is peculiarly adapted by climatic conditions and location for general governmental agencies and also for the manufacture of aircraft and parts. A city of this type is not prepared for rapidly increasing demands on its public utilities, and so, like the other utilities, the sanitary sewers have grown by local extensions in an effort to keep pace with the population. The untreated sewage empties into San Diego Bay through nine separate and relatively short outfalls. Thirteen other outfalls empty into the Pacific Ocean through antiquated settling tanks. Over 60% of the portion of San Diego Bay shore which is in the city limits is used by the Government for a Destroyer Base, Marine Base, Naval Training School, and other purposes. Each of these establishments contributes considerable sewage to the bay. For over twenty years, the State Board of Health has urged the development of some means of solving the sewage disposal problem.

The City Board of Health recently made a bacteriological survey of San Diego Harbor and Bay, with results so startling that the attention of all governmental agencies in the area was directed to them. In April 1940, a brochure was prepared showing the unsanitary conditions. Pictures were taken at each outfall, which in every case was located adjacent to or through federal property. The commanding officers of these establishments wrote letters discussing each individual problem relative to their establishment, and these letters were included in the brochure. The bacteriological survey, showing the B-coli count at each outfall and sewage field, was also included.

A solution to the problem was formulated (Fig. 1) to include a trunk sewer around San Diego Bay to intercept all outfalls and to carry the sewage to a proposed sewage disposal plant. Because of the imperative need shown by this report, the brochure was sent to Washington, D.C., for review. Through excellent cooperation of the Commandant of the Eleventh Naval District, the projects for sewage collection and treatment were put on the WPA National Defense list.

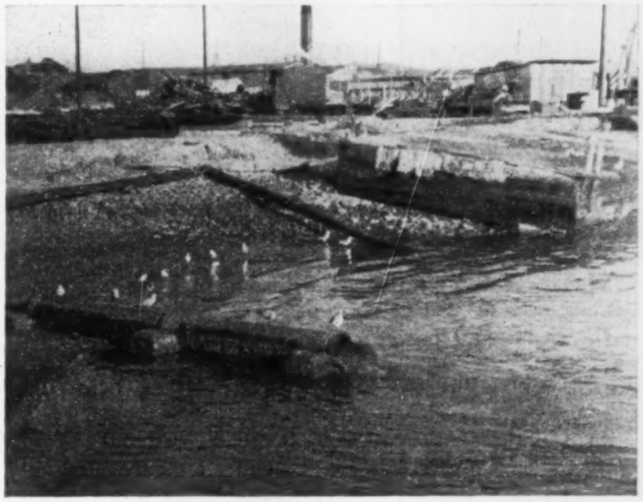
Immediately application was made for a sewage disposal plant to handle 15,000,000 gal per day, based on a population estimated at 200,000, of which only 75% would be served by the plant. The type of plant will be discussed later. Application was also made for a new outfall sewer large enough for the first design and for a trunkline sewer around the bay large enough for the ultimate estimated population that could be served, according to figures furnished by the City Planning Commission forecast. The applications made to the WPA were all approved and detail designs for the plant were started in 1940.

In the summer of 1940, the Federal Government decided to locate several large training camps for the Army and Navy near San Diego, also to increase the Navy personnel and to expend $50,000,000 or more on the Eleventh Naval District building construction and expansion plan. The housing problem in San Diego was becoming acute in the fall of 1940, owing to the influx of workmen, and therefore the Navy decided to construct two low-cost housing projects of about 600 units each to be used by Navy personnel.

This was followed by the announcement that the local aircraft industries planned to add 20,000 employees to their payrolls by 1942. For each employee this means an increase in population of at least three persons. The shortage of homes and living quarters caused the federal government to undertake a housing project for 3,000 families of national defense workers, followed by another barracks-type single-man unit for 750 men. This has again been followed by a large federal trailer camp and more barracks to house men.

Private construction has also proceeded at a tremendous rate with the result that the entire city has had a rapid growth, and the number of building permits has been about the second highest in the United States.

The sanitary sewer problem for several of the federal housing projects was finally solved by the construction of separate sewage disposal plants at each project, where it was impossible to reach the city's sewer system. The



Tremendous Population Growth Overtaxed Sewage System, with Consequent Pollution in San Diego Bay city-wide sewer problem was of a different nature. In 1940 the entire city was divided for study into drainage areas, the sewage from which would enter the various trunk outfall sewers, and locations were chosen to install gaging stations. On investigation at these points, the sewers were found to have sewage standing in manholes from 4 to 5 ft deep at high tide, and in many places sewage would boil out of manholes at peak flows. It was therefore necessary to relocate the gaging stations at points farther away from the outfalls.

The Palmer-Bowlus weir ("Adaptation of Venturi Flumes to Flow Measurements in Conduits," by H. K. Palmer and F. D. Bowlus, TRANSACTIONS, Am. Soc. C.E., Vol. 101, 1936, page 1195), made of sheet metal, was used very successfully in obtaining gagings. Experience with these weirs has shown the necessity of fastening the larger sizes in the pipes to prevent sliding. From the data collected, composite curves were compiled to predict the flow in the proposed trunk sewers and treatment plant. Early in 1941 it became apparent that studies should be made of all the sanitary sewers, especially after the gaging stations showed that the existing pipes were generally too small. This was called to the attention of the city manager, who requested further study and recommendations. As a result, the Council called an election for a bond issue totaling $1,983,000 to build additional trunk sewers to serve most of the city. This was voted.

For the design of the trunk sewers, $1^1/_2$ times the daily peak dry-weather flow was used, as determined from gagings. Because of the septic condition of the sewage before it reaches the treatment plant, and because of the large-size pipe required, it was decided to use reinforced concrete pipe lined on the upper two-thirds with glazed tile liners. This pipe is easily laid in any type of trench and can be fabricated locally. Semi-skilled labor can lay the pipe and fill the joints with an acid-resistant joint compound. Crushed stone, piles, or reinforced concrete slabs will be used as necessary in unstable ground to improve the foundation for the pipe.

The location of the treatment plant was a serious problem, because the city borders directly on the bay, and most of the vacant land was not suitable for a sewage treatment plant. A sufficiently isolated site was finally found at the junction of two trunk sewers near the head of an existing sewer outfall. The existing outfall below the treatment plant site was reconstructed to meet the 1940 requirements, but before actual construction was completed, an additional pipe was added to take care of the rapid increase in population and most of the ultimate demand.

In preparing the final plans for the disposal plant, it was decided best to build a plant in useful units that could be operated and extended to meet the requirements of a rapidly changing population. The industrial waste report shows some sewage loads contributed by industrial plants, chiefly canneries. The following composite population equivalents have been used to determine the volume and strength of these wastes:

Fish cannery	156 tons per day using a population equivalent of 250	= 39,000
Pepper cannery	32.5 tons per day using a population equivalent of 615	= 20,000
Breweries	333 bbl per day using a population equivalent of 3	= 1,000
	Total	60,000

Calculated per capita flows, from actual measurements of San Diego domestic sewage made in January 1941, are as follows:

Maximum flow	75 gal per day
Minimum flow	15 gal per day
Average flow	51 gal per day

In the design basis for the treatment plant, the following per capita flows were used to provide a factor of safety. The plant design is now based on a population of 375,000.

Maximum flow, 85 gal per capita per day	= 31.9 mgd
Minimum flow, 18 gal per capita per day	= 6.7 mgd
Average flow, 55 gal per capita per day	= 20.6 mgd
Suspended solids (domestic sewage)	= 385 ppm
Suspended solids (including some garbage)	= 460 ppm
Sulfates in San Diego water	= 20 ppm
Age of sewage at plant	= 1 to 10 hr

To facilitate the calculations, the industrial wastes were considered to have the same strength as domestic sewage and to have a larger factor of safety because of their greater dilution.

Because San Diego Bay is a large body of water subject to tidal action and with sufficient depths at the pier-head line to provide good dilution, primary treatment of the sewage is all that is considered necessary. The sewage will enter the treatment plant site through hydrau-

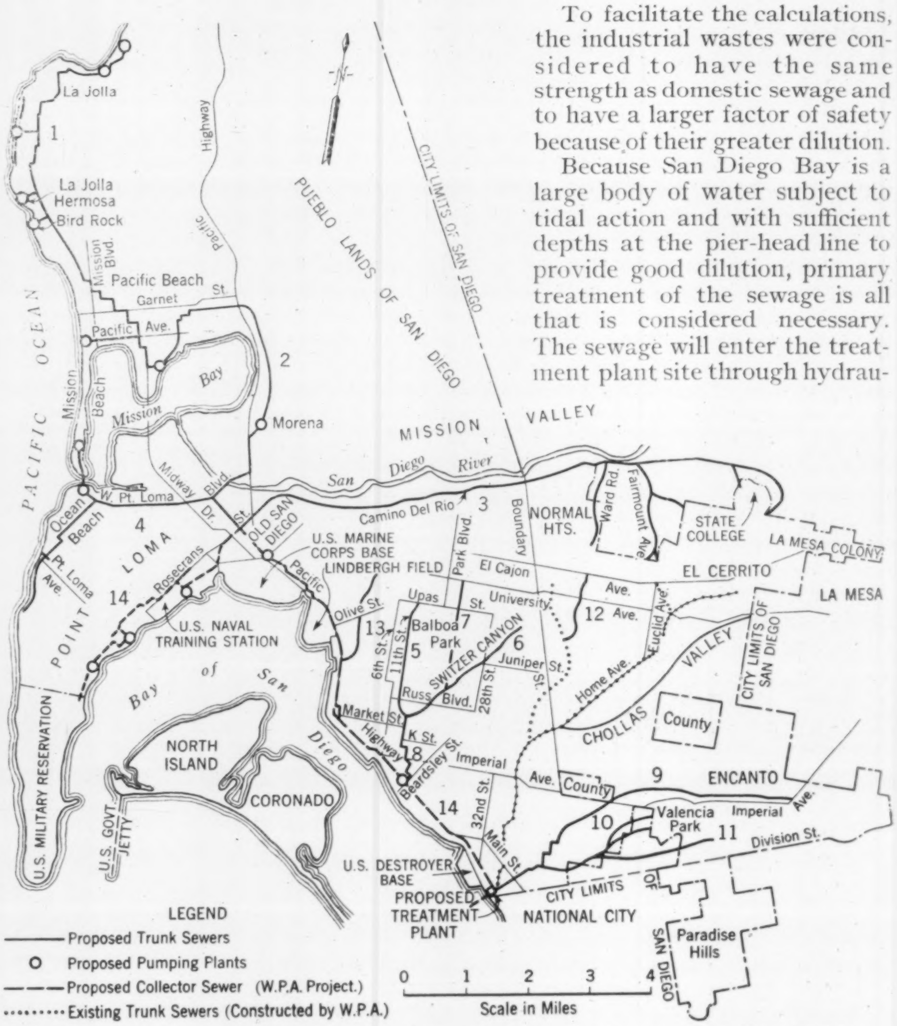

N
La Jolla
1
La Jolla Hermosa
Bird Rock
Highway
Pacific
Mission Blvd.
Pacific Beach
Garnet St.
Pacific Ave.
PACIFIC OCEAN
PUEBLO LANDS OF SAN DIEGO
CITY LIMITS OF SAN DIEGO
2
Mission Beach
Mission Bay
Morena
MISSION VALLEY
San Diego River
Midway Dr.
Blvd.
St.
W. Pt. Loma
Ocean Beach
4
POINT LOMA
OLD SAN DIEGO
Camino Del Rio
3
Park Blvd.
Boundary
NORMAL HTS.
Ward Rd.
Fairmount Ave.
STATE COLLEGE
LA MESA COLONY
U.S. MARINE CORPS BASE
LINDBERGH FIELD
Pacific
El Cajon
EL CERRITO
Pt. Loma Ave.
Rosecrans
14
U.S. NAVAL TRAINING STATION
Olive St.
Upas St.
University Ave.
Ave.
12
Euclid Ave.
LA MESA
13
Balboa Park
7
5
6
6th St.
11th St.
SWITZER CANYON
Juniper St.
Russ Blvd.
28th St.
Home Ave.
VALLEY
CITY LIMITS OF SAN DIEGO
Bay of San Diego
Market St.
Highway
K St.
8
Beardsley St.
Imperial Ave.
CHOLLAS
County
NORTH ISLAND
CORONADO
County
9
ENCANTO
U.S. MILITARY RESERVATION
U.S. GOVT. JETTY
14
32nd St.
Main St.
10
Valencia Park
Imperial Ave.
11
Division St.
U.S. DESTROYER BASE
PROPOSED TREATMENT PLANT
CITY LIMITS OF SAN DIEGO
NATIONAL CITY
Paradise Hills
LEGEND
Proposed Trunk Sewers
O Proposed Pumping Plants
Proposed Collector Sewer (W.P.A. Project.)
Existing Trunk Sewers (Constructed by W.P.A.)
0 1 2 3 4
Scale in Miles

FIG. 1. PLAN OF SEWAGE COLLECTION AND DISPOSAL SYSTEM FOR SAN DIEGO

lically operated automatic sluice gates so arranged as to by-pass the plant in case of power failure.

The plant units will perform the following functions in the order of flow (Fig. 2): (1) odor control and/or sterilization; (2) comminution of solids; (3) grit removal; (4) sewage pumping; (5) aeration for flotation of scum and grease; (6) vacuum removal of scum and grease; (7) combined flocculation and sedimentation; (8) measurement of quantity of plant effluent; (9) separate digestion of sludge, scum, and grease; (10) additional sludge thickening; (11) vacuum filtration of digested sludge; (12) flash drying of filtered sludge; (13) dried sludge storage; and (14) disposal of plant effluent into bay.

For odor control there is one installation for making ferrous-ferric chloride solution from scrap iron and chlorine, with a capacity of from 59 to 500 lb of chlorine, or 100 to 1,000 lb of ferrous chloride per day. In addition, there will be one 1,000-lb-per-day chlorinator with provision for enlargement to 2,000 lb per day. Two solids grinders (each having a capacity of 20 mgd) installed in the sewage inlet channels, will reduce all solids to $^3/_8$ in. minus. One 20-ft-diameter grit-removal and washing installation is used. A duplicate unit will be added if required. Anticipated average removal is 1 to 2 cu ft of washed grit per million gallons, containing 5% volatiles.

Seven pumps operated by a program control will give 1,000-gal per min changes in pumping rate between 1,000 gal per min and 32,000 gal per min (46.1 mgd). The pump sizes are as follows:

No. of Pumps	Size	Capacity, Gal per Min
2	14 in.	8,000–10,000
1	12 in.	6,000
1	12 in.	4,000
1	8 in.	3,000
1	8 in.	2,000
1	5 in.	1,000

The 14-in. pumps are designed so that larger impellers can be installed in them. The motors are of sufficient size to carry the additional load.

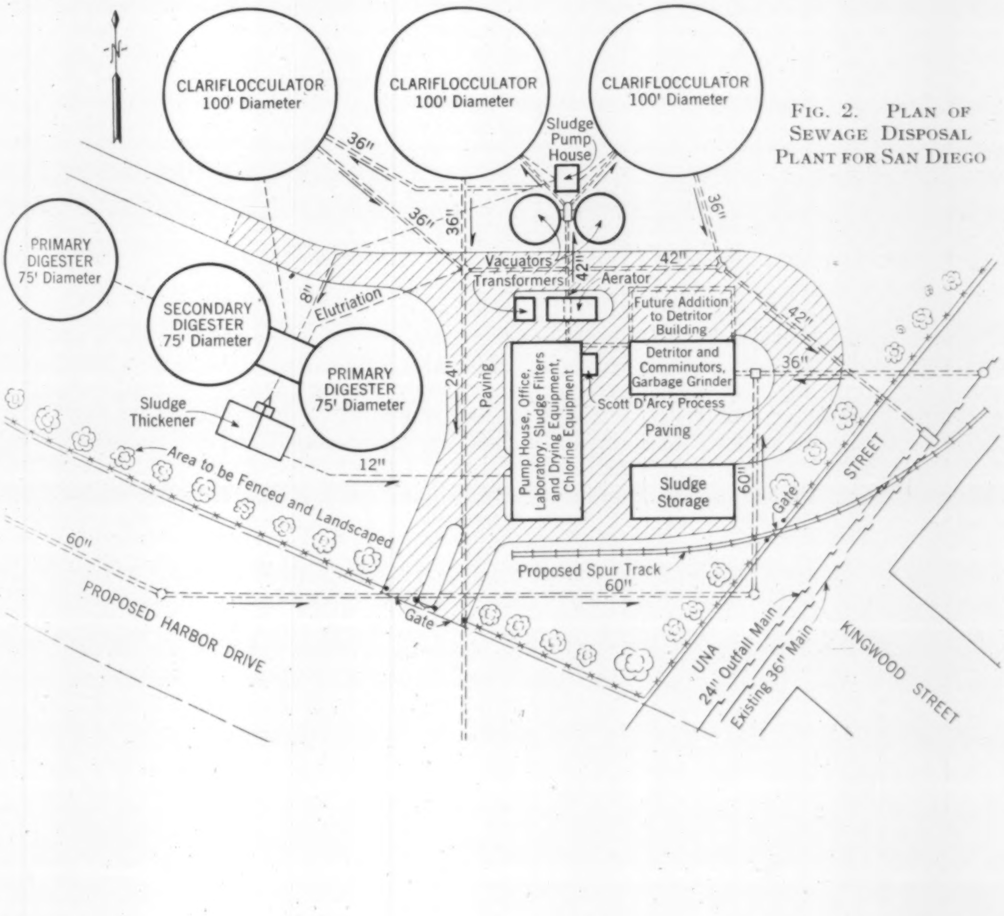

N
CLARIFLOCCULATOR 100' Diameter
CLARIFLOCCULATOR 100' Diameter
CLARIFLOCCULATOR 100' Diameter
Sludge Pump House
36"
36"
36"
36"
PRIMARY DIGESTER 75' Diameter
SECONDARY DIGESTER 75' Diameter
PRIMARY DIGESTER 75' Diameter
Sludge Thickener
8"
Elutriation
Vacuators
Transformers
42"
42"
Aerator
42"
Future Addition to Detritor Building
Detritor and Comminutors, Garbage Grinder
36"
24"
Paving
Pump House, Office, Laboratory, Sludge Filters and Drying Equipment, Chlorine Equipment
Scott D'Arcy Process
Paving
Sludge Storage
60"
12"
Area to be Fenced and Landscaped
60"
Proposed Spur Track
60"
Gate
Gate
STREET
PROPOSED HARBOR DRIVE
UNA
24" Outfall Main
Existing 36" Main
KINGWOOD STREET

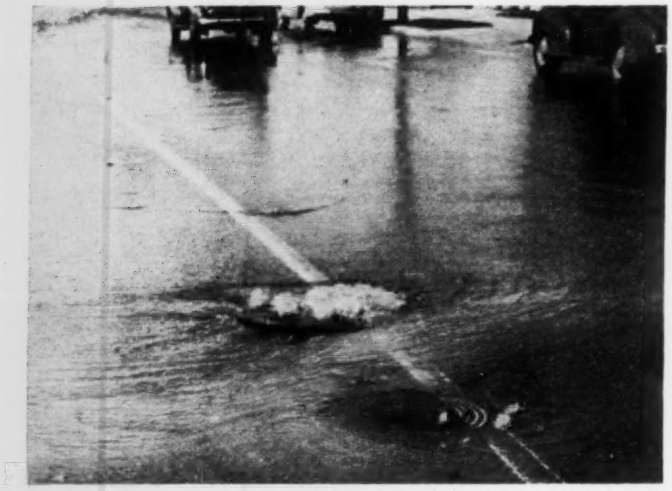
Fig. 2. Plan of Sewage Disposal Plant for San Diego

Old Sewage System, Now Inadequate, Emptied Directly Into San Diego Bay

Two concrete aeration tanks 11 ft 8 in. square, with a water depth of 10 to 14 ft, operate in parallel, each having one 100-cu ft per min positive pressure blower delivering air through a perforated pipe distribution system and a vertical propeller-type flash mixer. Either one or both of the aerators can be by-passed as desired. Both blowers can deliver air to either one of the tanks. The aeration surface can be increased 30% by applying air in the control boxes between the aerators.

To remove scum and grease, two concrete vacuum tanks 35 ft in diameter with a 10-ft water depth, maintain a 10-ft vacuum by means of air pumps. Each tank is to be equipped with a mechanism for skimming off scum and scraping out sludge. Based on pilot plant results at Terminal Island (Los Angeles, Calif.), they are expected to remove most of the scum and grease and part of other suspended solids, or a total of 30% of the suspended solids in the raw sewage. The tanks are to be in parallel. The scum will be pumped to the digesters, and the sludge kept in the sewage.

For the primary sedimentation of sewage there will be a combined flocculation and sedimentation unit consisting of three combination flocculator-clarifiers operating in parallel. These will be 100 ft in diameter with a 12-ft sewage water depth. The inner flocculating compartment is to be of steel with mixing by motor-driven paddles. The outer sedimentation compartment is to be of concrete with equipment to remove sludge and scum. The expected removal, with vacuators by-passed, is 60% of the suspended solids in the raw sewage. The expected overall plant removal with vacuators in



AT HIGH TIDE SEWAGE BACKED UP IN MANHOLES AND IN SOME CASES FLOWED OUT ONTO THE STREET

service is 75% of the suspended solids in the raw sewage.

One 30-in. concrete Parshall flume is to follow each flocculator-clarifier. Each is to have a useful capacity of 25 mgd. Recording meters are to be used on each flume.

The garbage added to the sewage will be removed as sludge or scum and pumped to the digesters. Equipment for this purpose will consist of two concrete primary tanks operated in parallel and one concrete secondary tank. The primary tanks will be of the covered, heated type 75 ft in diameter with a 33-ft sewage water depth. The secondary tank, 75 ft in diameter by 33 ft in sewage water depth, will have a floating cover. The capacity of each tank is 145,600 cu ft. The supernatant will be returned to raw sewage. Daily withdrawals of sludge from the secondary tank for drying will materially increase its capacity.

To eliminate the use of lime for sludge conditioning, sludge thickening and elutriation after digestion will be accomplished in two concrete tanks 20 ft in diameter by 10 ft in sewage water depth, connected in series for two-stage or countercurrent treatment. Mechanisms will be provided for sludge removal. It is proposed to use the plant effluent for washing the sludge. The capacity of the two tanks is based on the sludge dryer capacity of 1,570 lb of dry solids per sq ft per hour.

There will be two continuous vacuum filters, 5 ft 4 in. in diameter by 10 ft long, having a design capacity of 5 lb per sq ft per hr. Sludge is to be pretreated by one-minute mixing with purchased ferric chloride solution. The filter capacity is based on dryer capacity and varies between 1,570 and 1,080 lb per sq ft per hr. The filters are expected to reduce the water content from 90% in the sludge to 70% in the cake.

Sludge cake will be dried from a water content of 70% to that of 10% by intimate mixing with hot air in a flash dryer. All odorous gases will be heated to 1,300 F to eliminate odors. Heat is to be supplied by the combustion of digester gas. A commercial natural gas stand-by connection with the San Diego Gas and Electric Company will be provided for emergencies, or if a sufficient quantity of digester gas is lacking. The dryer (as well as filters and thickeners) is to be operated 16 to 24 hr per day and a sufficient number of days per month to keep up with the rate of production of the digested sludge.

Effluent will be discharged into San Diego Bay through a concrete pipe 42 in. in diameter in parallel with a vitrified tile pipe 24 in. in diameter. The ends of the outfalls will be 45 ft below high water and have three multiple vertical outlets on the 42-in. pipe, and a single outlet on the 24-in. pipe. These pipes will extend 1,200 ft from the quay wall, over which distance the 24-in. pipe will be reclaimed cast iron.

The plant was designed for immediate construction to serve a population of 250,000 and future duplicate additions to serve a population of 375,000. After the approval of the bond issue and the recent promise of more federal aid, the future units became a part of the present construction program. Sufficient land has been acquired to more than double the plant as now designed. This will permit addition of similar units, or units for additional treatment if ever required, adjacent to the present plant. Since these figures have been compiled, two more large federal housing projects have been announced, the aircraft factories have received larger orders, and it is rumored that some of the naval and military establishments may be enlarged.

The project has been financed as follows: For the outfall sewer, the WPA is furnishing $101,000 and the city of San Diego $7,500. For the sewage treatment plant, the WPA is furnishing $370,400, the city $86,366, and the U.S. Navy $100,000. For the main intercepting sewer around San Diego Bay, the WPA is furnishing $1,435,200, the city $70,500, and the U.S. Navy $100,000. For additional trunk sewers, the city is furnishing $1,983,000, as authorized by the recent bond election. Thus a total of $4,253,966 has been allocated to date for the control of the sewage collection and treatment problems made so acute by national defense.

STATUS OF THE WORK

By October 1, 1941, all the functional equipment for one major pumping station and 98% for the sewage plant had been purchased. Deliveries have been delayed by lack of sufficient priority ratings. One pumping station had been built and placed in emergency operation. The treatment plant was about 30% complete, and the intercepting sewer being built by the WPA was about 14% complete. The city had filed applications with the WPA and the PWA for additional funds to complete the treatment plant and intercepter sewer respectively. The project is expected to be completed in the fall of 1942.

POLLUTION LITTERS THE SHORES OF SAN DIEGO BAY
It Is This Condition Which the New Program Is Designed to Remedy

Work is progressing rapidly. The WPA personnel consists of elderly men from different trades who are unable to accept private employment and keep up under constant hard work. Mechanical equipment is being used to rush the construction. The supervision on the project is furnished by the City Engineer's Office, and a city inspector is on each project. The WPA has an efficient crew of superintendents and an excellent clerical force. The entire plan of the work was prepared by men in the City Engineer's Office. All detail drawings and specifications and orders for materials were prepared by the City Engineer's Office. A consultant was retained on the preliminary design and control.

The Parking Problem in the Business District

With Special Reference to California Cities

By John G. Marr, M. Am. Soc. C.E.

Engineer, City Planning Commission, Oakland, Calif.

Downtown Merchants' Parking Assn., Oakland, Calif.

Parking Space in Oakland, Calif., Provided by Downtown Merchants' Parking Association

When any condition affects the pocketbook and every-day convenience of the general public as does the problem of parking, it is inevitable that action of some sort will be forthcoming. Therefore, in a discussion of this problem the first logical question is: What has already been done? Various solutions have been attempted and these will be discussed in four general categories—surveys, use of temporary expedients, parking meters, and off-street parking lots.

In order to understand the existing conditions, numerous comprehensive traffic surveys have been conducted, both public and private. These have all emphasized the magnitude of the congestion and the inadequacy of the available parking space in the particular city concerned. A survey of national scope, entitled "The Parking Problem in the Central Business Districts," was undertaken by the American Society of Planning Officials and the International City Managers' Association, and published in 1938 by the Public Administration Service. This report was a beginning and provides interesting data and valuable comments on what has been attempted in a number of cities.

The American Automobile Association, through a special committee, is now engaged in studying the subject further. A progress report was completed in January 1941. One other survey, under the direction of the Bureau of Street Traffic Research of Yale University, is deserving of mention. The prospectus for this comprehensive study of the parking problem was recently issued, and is one of the most complete outlines presented to date.

Even before comprehensive traffic surveys were undertaken, the urgency of the problem in particular localities resulted in the use of various temporary expedients. A time limitation on parking at the curb was first invoked. The second step was to eliminate all parking where the requirements of moving traffic could not be cared for in any other way. Increases in the volume of moving traffic forced enlargement of areas where parking was prohibited.

The same organization will often inconsistently demand both the elimination of congestion and more area for curb parking. Such a demand can only be properly answered by securing additional facts. Surveys in various cities have indicated that the amount of business ascribable to customers using curb parking is relatively small—between 1 and 10%. However, the average merchant will only change his attitude when convinced by irrefutable facts, probably supplemented by a practical demonstration.

Up to March 1, 1941, over 250 cities throughout the United States had attempted to simplify their enforcement problem by installing parking meters. Reports of the success or failure of this effort are now available, and the trend appears to be toward more universal acceptance of this aid to enforcement, primarily because it is productive of results. However, the installation of parking meters in any city should not be done on the basis of personal opinion, without a thorough analysis of the local parking conditions, the amount of present enforcement, and some estimate of the extent of probable enforcement after the installation. Other factors must also be given consideration, including the compactness of the business district, the distribution of the population in relation to the business district, the width and grades of streets, the size of blocks, the availability of alleys or off-street loading space, the necessity for loading zones along the curb, the extent of the no-parking area needed to meet the requirements of moving traffic, special curb uses such as for taxis and hotels, the effectiveness and use of mass transportation agencies, and the ratio of automobiles to population and trends of use.

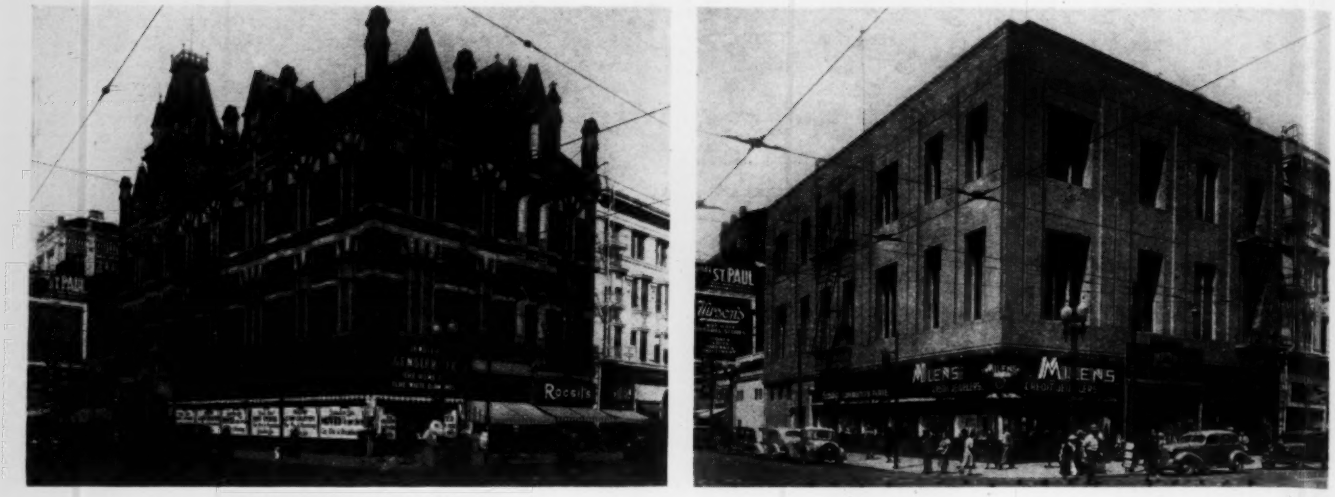
As long as mass transportation and close-in residence continues, the central business districts of cities could serve effectively as shopping centers. With the almost universal ownership of automobiles, the situation has changed completely. Express highways and freeways now lead to the old central business districts, increasing congestion and decreasing the available parking space. The obvious effect on business activity is strangulation at the old center. Either business must move into less crowded areas or parking space must be provided. What has been done and what can be done to remedy these conditions is here discussed by Mr. Marr. His paper was originally delivered before the City Planning Division at the Annual Convention in San Diego in July.

POLLS FAVORABLE TO PARKING METERS

Where cities have installed meters in accordance with a sane and logical plan, the public acceptance has been reported as favorable. Polls conducted by the City Club of Portland, Ore., were 84% of a 3,000 sampling in favor of meters. In Meadville, Pa., a poll with a sampling of only 400 indicated 84% in favor. The populations of these cities are approximately 300,000 and 17,000, respectively. The one has over 1,400 meters, the other 400. The one is on the Pacific and the other close to the East coast.

The results that seem to follow from the use of meters have been reported from many cities where the meters have been in use for a sufficient length of time to justify conclusions. Briefly, these results are:

1. Reduced traffic congestion through a decrease in the amount of parking and cruising.
2. Increased curb turnover—in Portland there was an increase of 54% on observed selected blocks. Also parking space is reported to be available near destination, instead of a long distance away.
3. Greater ease in parking due to allocation of 20-ft space to a stall, not 17 or 18 ft, or haphazard arrangement, as happens when stalls are not marked.
4. More satisfactory enforcement, although only approximately 70% pay, 30% using the unexpired time of the man with the nickel. The survey and limited personal



Downtown Merchants' Parking Assn., Oakland, Calif.

MODERNIZATION OF OLD BUILDINGS IS USED TO OFFSET DECENTRALIZATION
Before, at Left; After, at Right

observations indicate that violations are between 5% and 12%. In one city the degree of meter failure in a year was less than 0.7 of 1%, and slugs constituted only $86 out of the take of $135,500.

5. Increased revenue which can be applied to enforcement. Such revenue should be used solely for improving traffic facilities. However, revenue should not be the primary reason for a meter installation.

NEED FOR OFF-STREET PARKING SPACE

The fourth solution to be discussed is off-street parking lots. There are privately owned parking lots in practically every city of any size. These are generally created by the removal of old structures, a procedure that usually improves the city's appearance and saves the owners' taxes. Many of these parking projects can only be considered as temporary—awaiting the time when the land will be converted to more intensive use.

There is definite need for free off-street parking space, and some efforts have been made in this direction. In 1929 the Downtown Merchants' Parking Association of Oakland, Calif., was organized as a non-profit cooperative association of retail merchants to provide such facilities for their patrons. Included in the 150 members of the Association are banks, retail shops, title insurance companies, theaters, professional offices, and every other type of business found in the central business district. The members of the organization validate the parking tickets of their customers and are charged in proportion to the total number of validations approved, based on a net operating cost. Generally speaking, no purchase is required to secure validation since this is considered an effective means of advertising. The extent of this activity is shown by the following statistics:

Year	Number of Stalls Available	Number of Cars Parked Per Year
1930	581	496,858
1935	656	711,356
1939	764	1,084,726
1940	*764	1,250,000

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* Increased to 811 spaces in 1941.

The provision of these off-street parking stalls has partially offset the reduction in the number of curb stalls.

It is interesting to note that as the number of cars parked has increased each year, the average cost to the merchants for validation has been reduced. For the year 1930, the average cost was 7.1 cents per car, while in 1939 it dropped to less than 5 cents. The average turnover per stall per year has increased from an average of 850 cars in 1930 to 1,420 in 1939. The daily turnover for individual stalls is from 7 to 10 cars during a 10-hour period.

In some cities, public parking areas have been provided. The majority of these are cities of the smaller size, where areas are available or where special conditions dictate such action. A summary of parking lots provided in various cities is contained in "The Parking Problems in the Central Business District," previously referred to.

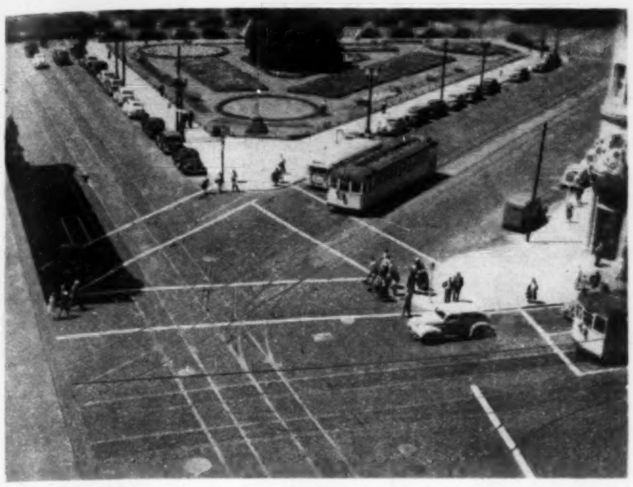
Under California statutes it is possible for a municipality to acquire land for parking purposes. The 1903 Street Opening Act and the Automobile Parking District Act of 1941 permit the acquisition of public parking areas. To my knowledge this procedure has never been invoked. But if the problem continues to be as serious as it is at present, or if it becomes worse as seems likely, there is little doubt that California cities will be forced to take advantage of one of these Acts.

In Oakland, a partial solution to the problem of finding space for municipal cars has just materialized. The old Oakland High School is being wrecked and the site thus made available will unquestionably be used for this purpose. Sites of this type, no longer needed for specific municipal purposes, might better be used for parking than remain idle. There are examples of tidelands, school sites, market areas, filled-in lake or river front, and canal areas, which have been developed for parking.

COMPREHENSIVE SURVEY SHOULD PRECEDE ACTION

So far I have merely attempted to indicate what has been done. This discussion would be incomplete without some mention of what steps can be taken toward solving the problem. Since parking has so many and diverse ramifications and affects so many elements in the urban structure, it is necessary first to assemble more information and really analyze it as to cause and effect. The facts for each city must be obtained. Surveys should be comprehensive along the lines outlined by the Yale Bureau of Street Traffic Research, and should include an analysis of traffic conditions correlated with related social and economic phenomena.

The second step is to adjust all the temporary expedients now being used so that each will function to its maximum effectiveness. Or in other words, the use of no-parking areas, restricted time limitations, and the location of loading zones and special parking privileges must be determined on the basis of their engineering justification. The use of traffic regulatory devices, including traffic signals and stop signs, must have similar justification. Proper enforcement of all these temporary expedients is absolutely necessary if they are to function. The police have a part to play in solving the parking problem. This may necessitate the use of mechanical aids to enforcement in some cities, and it will necessitate the adoption of a policy of treating all individuals and organizations alike in all cities.



Channelization for Convenience of Pedestrians Is Necessary at the Most Congested Points

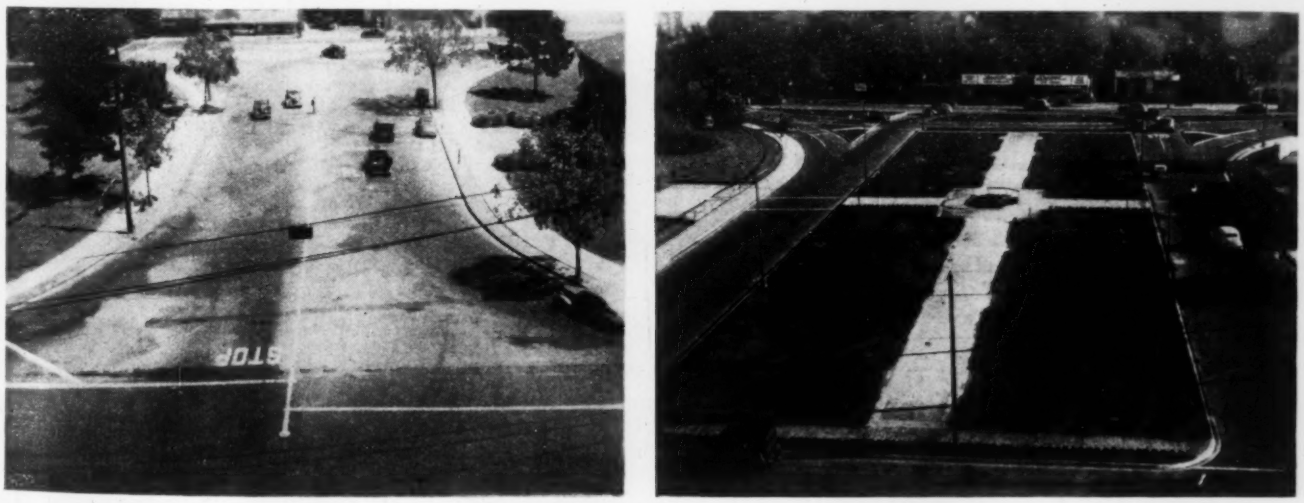
The third necessary step is the preparation of plans for the provision of off-street parking areas. They must be designed to provide for the varying fundamental requirements, including: (1) easily available space for short-time parking, (2) convenient space for two-hour parking, and (3) an adequate area providing for the long-time parkers, including employees and employers. In planning for these fundamental requirements it is essential that the matter be made one of joint responsibility. The merchants must cooperate in supplying the first two requirements, whereas the municipality should meet its responsibility by assisting in the third. We in Oakland are striving to prepare such a plan. It is still very much in the embryonic stage and of course the final program may or may not be in accord with preliminary findings.

There is one important element affecting the parking problem which has not been discussed. That is mass transportation. No terminal parking facilities are required for this form of transportation, and greater use of it would be of material benefit in lessening congestion and eliminating the worry and irritation which the vehicle driver suffers in trying to find a parking space. The economics of mass transportation deserves closer analysis by the agencies of government and the organizations engaged in providing the service. It might be possible to achieve at the same time more efficient use of the streets and lower transportation cost to the low-income worker.

The fourth step in solving the parking problem is to translate the plans from the blueprint stage to actual accomplishment. Here we run into a practical difficulty. The immediate reaction to a comprehensive plan is that it costs so many millions of dollars and consequently is impractical. However, it is not necessary to acquire all parts of the planned facilities at one time. Gradual development on a pay-as-you-go basis is desirable. There are many instruments or tools which can be invoked to assist. Zoning ordinances and building codes, which offer possibilities for controlling the density of population, the use of land, and the fundamental requirements for off-street loading and parking, are vital. The use of setback lines for the development of distributor streets at the periphery of the business area can assist in a better distribution of the traffic load.

There is no call for discouragement. The problem of parking, which we have created, we can solve. It did not develop in fifteen minutes, and it will not be cured in that period of time. Technicians are capable of outlining a permanent, economic, and desirable solution. Public acceptance and collaboration will be necessary unless we are to upset the economic organization of the city.

The solution of the parking problem will do much to rehabilitate the central business areas of cities, although it is admitted that this is only one element of many which can contribute to such rehabilitation. Improvement in appearance, development of by-pass highways to remove traffic not destined for the central area, less concentrated land use, equalization of assessments, and other positive action, are equally essential elements.



Channelization Is Used to Separate Traffic
(Left) White Lines on a Wide Intersection, (Right) Traffic Island and Triangular Strips

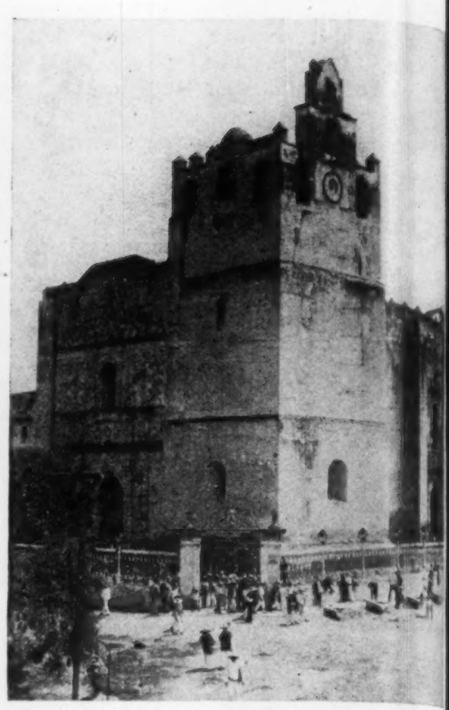
Mexican Irrigation in the Sixteenth Century

Great Water Supply Works Created by Early Builders Were Based on Sound Engineering Principles

By Francisco Gomez-Perez, Assoc. M. Am. Soc. C.E.

Chief of the Department of Statistics, Mexican Commission of Irrigation, Mexico, D.F., Mexico

Too often the early Spanish pioneers are thought of solely in terms of their conquests and explorations. An examination of their irrigation works proves that they also had outstanding engineering ability. Especially was this shown around the early missions, where the padres combined the missionary spirit with engineering and administrative talent. Prompted by excellent examples in their mother country and aided by an Indian civilization long experienced in irrigation, they planned and executed extensive projects without benefit of construction equipment. This paper by Mr. Gomez-Perez was presented before the Irrigation Division at the Society's Convention in San Diego.



Sixteenth Century Convent at Yuriria

Built by Augustinian Friars by Large Artificia

Lake of Same Name

The year 1519 marks the start of the expedition by Hernan Cortes into the high plateau of Central Mexico. There the Aztecs held political sway over the other Indian tribes, basing their power on the agricultural development of the land, which they held either directly or through conquered tribes. The final fall of Tenochtitlan, on August 13, 1521, before the Spaniards led by Cortes, initiated Spanish rule in New Spain, as that part of the North American continent was then called. The name of Mexico was given only to the capital city founded on the ruins of the Aztec zone conquered by Cortes and his men.

As usual in historical descriptions, the military feats have generally been given the spotlight. However, simultaneously with them important steps were taken towards the consolidation of Spanish rule. Among these the predominant ones were the religious influence, the establishment of appropriate laws, and the constructive effort that took place almost immediately, as soon as the conquistadores began laying aside their swords.

The most important influence was undoubtedly the religious one. The friars' work had deeper influence than the warriors'. The friars were not only preachers but also what we would call lawyers, doctors, architects, engineers, and so on. The Franciscans, the Jesuits, and the Augustinians might also be called the builders of the sixteenth century in Mexico. Especially the Augustinians, who established their convents in arid regions, might be called the irrigation engineers.

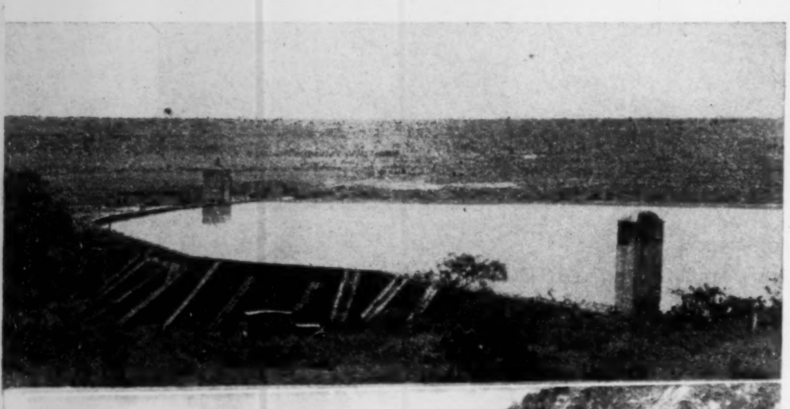
They were inspired not only by spiritual motives but also by the brilliant developments that were taking place with a rapidity previously unequaled in military conquest and exploration. Expeditions to the legendary seven cities of Cibola were being discussed, and the tropical regions of Michoacan and Jalisco on the Pacific slope were being further penetrated. Expeditions to the south, and to the tropical Isthmus of Tehuantepec and the Hibueras, now Guatemala, were also being carried on. The explorers traveled by sea as well as by land. Cortes himself had crossed the continent to the Pacific, had had ships built at the Bay of Acapulco, in some cases transporting timber hundreds of miles, and had started explorations to the northwest from this base, discovering the "Sea of Cortes," now called the Gulf of California. Some of his lieutenants had gone further northwards, among them Sebastian Vizcaino and Juan Rodriguez Cabrillo, the discoverer of the Bay of San Diego.

It should not, therefore, astonish us that the padres found time and energy, not only to build churches and teach Christian doctrine, but also to do what we would now call engineering work. They were the better fitted for such activities because they had come from a land, Spain, that is arid for the most part, and since the time of the Moors has had to rely on the storage and distribution of water. Also, they had come into a land where the control of water was of paramount importance to life.

The most important center of population they had conquered, and the place where Mexico City was founded, was located in a region of lakes. In fact, as part of the military effort to conquer the capital city of the Aztecs, the Spaniards had launched a group of small vessels on the lake at Mexico City and had had a battle on its waters. The Aztec city itself was referred to by contemporary writers as "New Venice."

The Indian rulers had considered flood protection of the capital city as one of their most important single problems. Chief among them, Netzahualcoyotl had been the directing influence and even the chief engineer, as we would now say, of a great dike, nine miles long and 20 ft high in some places, to protect the lake on which the city was located from the overflow of the nearby larger lake of Texcoco, into which most of the rivers in the closed watershed flowed. This dike, which required the labor of 20,000 Indians for its construction, was built as a result of the greatest flood of the period, which occurred in 1449.

Although intensive agriculture was not the predominant problem in the region as a whole, it was important in the center of population that was Mexico



A Good Example of the Work of the Nineteenth Century

Dam Across Morcinique River, State of Aguascalientes

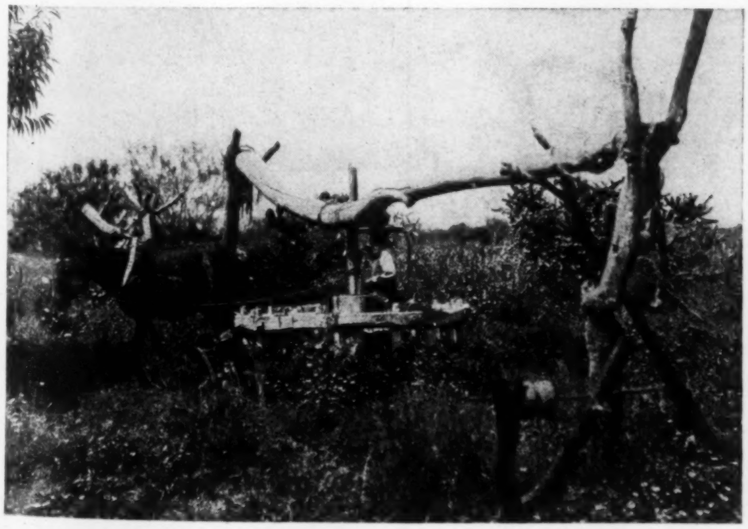
City, and in its environs. And here we find a method developed that is diametrically opposite to that followed in most arid regions. As water was abundant and earth was scarce, the problem was solved by bringing earth to the water instead of bringing water to the earth. Thus the famous floating gardens of Xochimilco, some 15 miles from the capital city, were started by accumulating relatively small amounts of selected soil on interwoven reeds that floated on the lake. As the centuries passed these became small islands, and later firm land resting on the floor of the shallow lake. The place has now largely lost the appearance of a lake and looks rather like land traversed by a series of canals.

EARLY LAND RECLAMATION

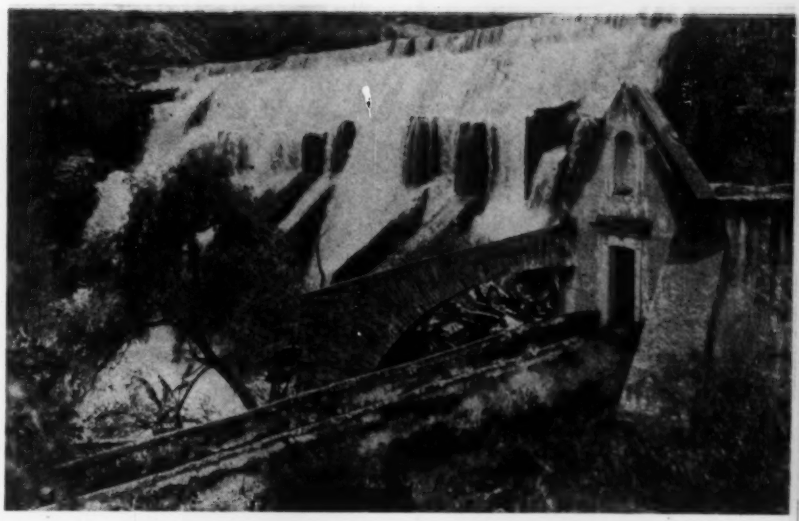
Just a few years after the coming of the Spaniards to Mexico, we find a Franciscan friar, Padre Nicolas de San Pablo, a relative of King Charles I of Spain, doing engineering work connected with land reclamation. Some one hundred miles northeast of the capital city of the colony, at a high altitude, lay the lake of Metztitlan, about 10$^1/_2$ miles long and 1$^1/_2$ miles wide. The volume of this lake varied within wide limits, leaving very useful lands on its margin capable of producing important crops when it shrank, but destroying the value of these lands when its volume increased. Practically four centuries ago Padre Nicolas de San Pablo started a cut in the lower side of the lake to connect it to a lower watershed, and thus laid the basis for a plan of development which, although impracticable with sixteenth century construction methods, has time and again served as the starting point for work done in the region and forms the basis for the present solution to this problem of land reclamation.

A contemporary Franciscan, Padre Juan de San Miguel, diverted the waters of various small rivers in the plains of Uruapan, to the northeast of the capital city, and caused them to flow through canals. This system was used again in the last few years to establish a small irrigation district in the same part of the country.

Still another contemporary, Padre Francisco Marin, traveled southwards to the Isthmus region, which, because of meteorological conditions, suffers from excessive precipitation in some parts, and complete lack of it in others. Where water was scarce, Padre Francisco Marin diverted it from the rivers and applied it to the land.



Moorish Irrigation Wheels Were Used in New Spain
This Land Is Now in the Pabellón Irrigation District, in the State of Aguascalientes



Old Pabellón Dam Over Pabellón River, State of Aguascalientes; on the Right Is the Old Mill

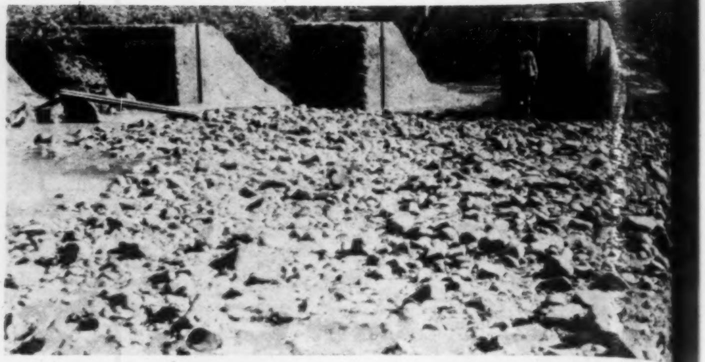
But the most impressive work along these lines in the sixteenth century, and that which most resembles the large-scale projects of our own day, was done by an Augustinian, Padre Diego de Chavez. In 1548 he conceived and started the development of the lake of Yuriria. Not only did he divert the waters of a river into swamp lands, to form this natural reservoir, but he also connected the lake to the nearby lake of Cuitzeo by means of a cut, thus getting the benefit of the rivers and creeks that fed into the latter. The lake of Yuriria is some ten miles long, four miles wide, and includes several islands.

The water stored in this lake is still the source of supply for nearby lands. The waters flowing into Lake Cuitzeo, which he connected with Yuriria, have in the last few years been stored in the Cointzio Reservoir, in order to drain swamp lands, make more water available for irrigation, and provide for the future development of hydroelectric power. The details have changed, but the general conception of the problem is similar to that of four hundred years ago.

Water was needed not only for these large irrigation developments, but also to supply the convents and seminaries which were founded in considerable numbers. Thus at Tepotzotlan, where the Jesuit Fathers established a seminary, Padre Luis Ahumada built a covered flume and an open canal to carry the water for the use of the seminary and the Indians. For the open canal he established an organization of caretakers somewhat similar to the ditch riders of recent times. Thirty years before this construction, the Augustinians, in 1560, built a masonry aqueduct 33,000 ft long, to bring water to the arid lands surrounding their massive convent at Actopan. The Augustinians also built supply conduits for their convents at Tiripitio and Cuitzeo, not only for their own use but also to supply the land cultivated by the Indians in their jurisdiction.

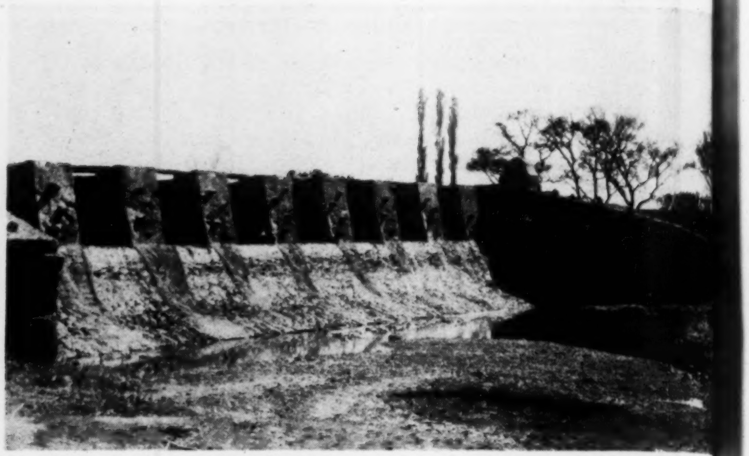
In this description of sixteenth century water supply and irrigation projects, mention should be made of the first town built as the nucleus of an irrigation district. Just a few years after the sixteenth century had ended, in the year 1603 to be exact, the Spanish Viceroy, Marques de Montes Claros, signed a decree authorizing the establishment of the town of Salamanca in the Bajio area of Central Mexico, near Lake Yuriria. Here the waters of various small streams and tributaries of the Lerma River could be diverted to agricultural lands on

SAUCILLO DAM OVER SAUCILLO CREEK

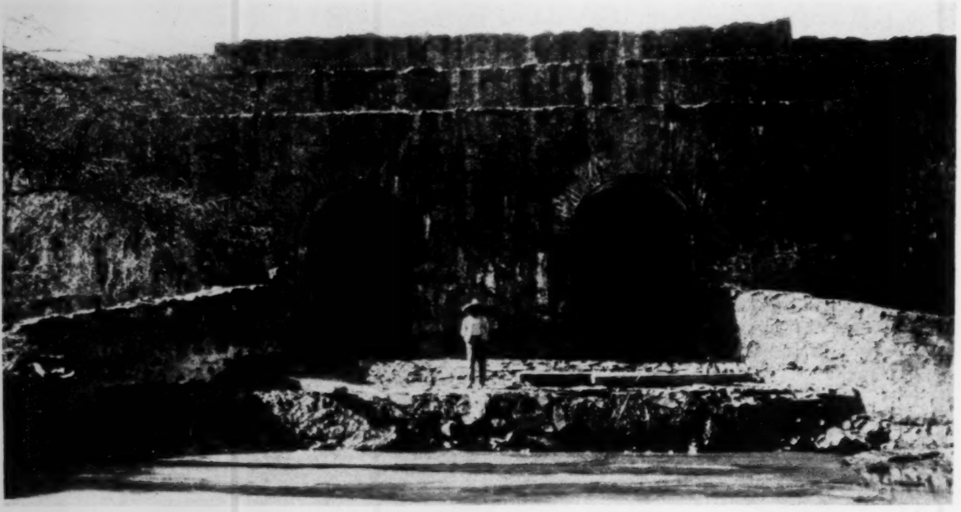


DAM OVER COSCOMATE RIVER DIVERTS WATER TO JILOTEPEC

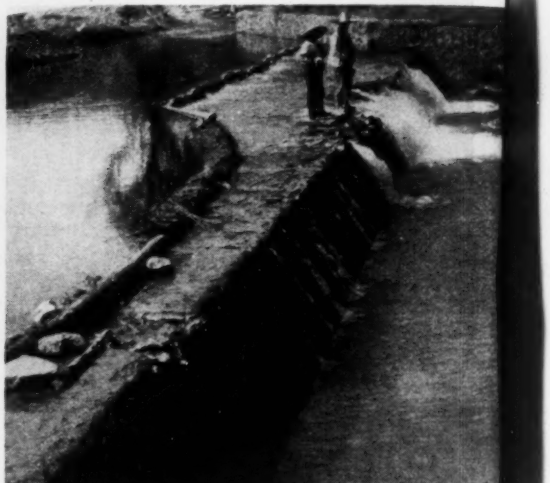
ST. CATARINA AQUEDUCT, STATE OF MEXICO



CADENAS DAM OVER THE SALT RIVER

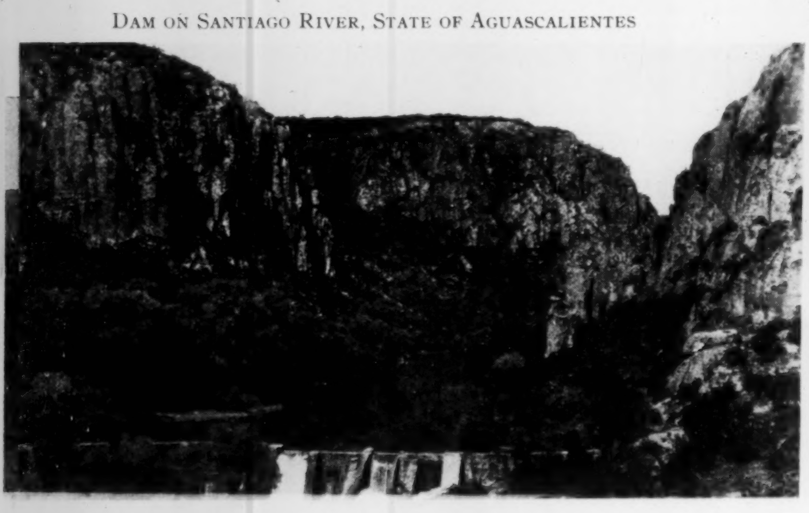


SAN RAFAEL DAM, STATE OF HIDALGO

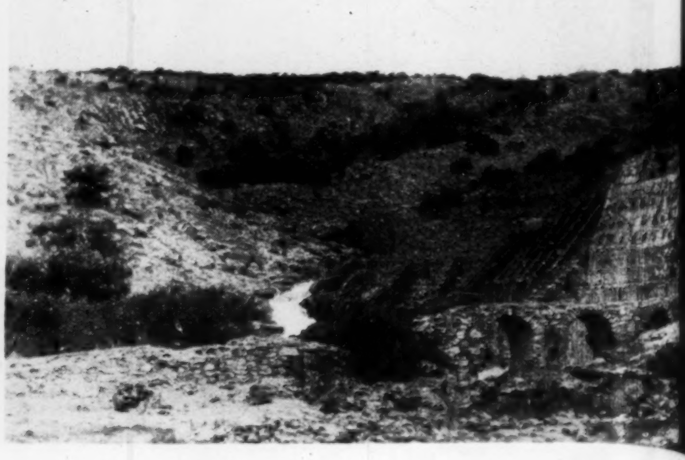


DAM ON CONCEPCION RIVER, STATE OF HIDALGO

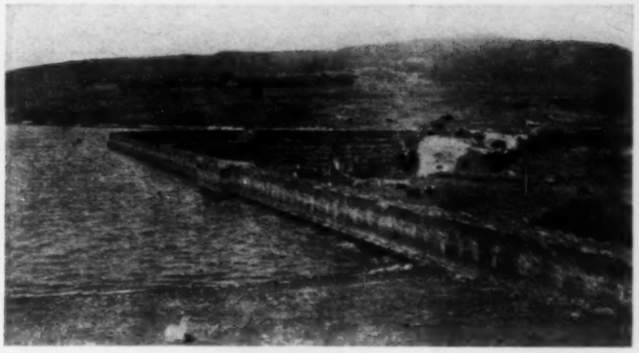
DAM ON SANTIAGO RIVER, STATE OF AGUASCALIENTES



AQUEDUCT AND MORCINIQUE DAM ACROSS SANTIAGO RIVER



Cadenas Dam on the Salt River, State of Mexico
Sluice Gate Is on the Right Margin



Concepcion Dam Across Tlautla River, State of Hidalgo
Masonary Structure of Step Construction

which descendants of the conquistadores had their homesteads. New settlers arrived, and the city of Salamanca became the first town on the North American continent whose existence was based on an irrigation development.

CONCEPT OF MULTIPLE USE OF WATER

Water was essential not only to irrigate the land but also to provide drinking water for the settlers. Even then the concept of "multiple use" was being taken into consideration. The Spanish builders had come from a country whose canyons the Romans had bridged with high and massive arches for their aqueducts. The centuries had not been able to destroy these remnants of an earlier civilization. It was natural that the same pattern should be followed in this new colony across the sea, which even in its name, New Spain, expressed its determination to follow closely in the steps of the mother country.

As early as 1541 an aqueduct was being built at Tepeapulco with a length of 16 miles. Even though not completed until two centuries later, it marked the beginning of this type of construction in the new world.

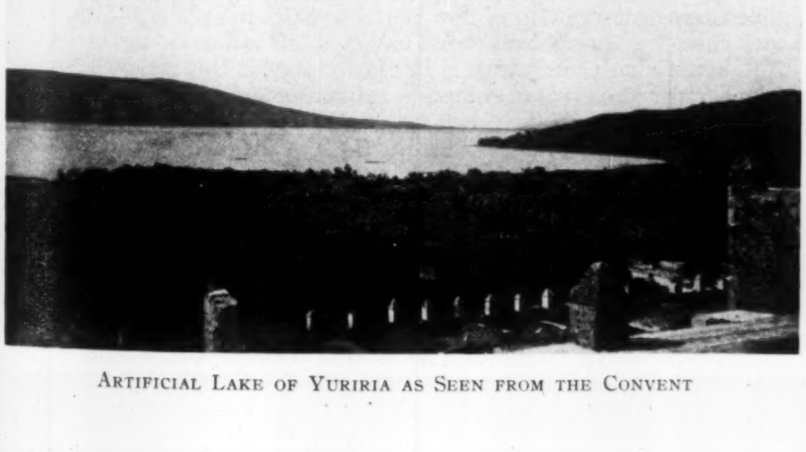
In 1567 the Franciscan Friars found that the nearest water to their proposed convent at Epazoyucan was seven and a half miles away. They solved the problem by building a masonry aqueduct. But the most important effort in this line was carried on in the 17 years from 1570 to 1587, under the direction of another Franciscan, Padre Francisco de Tembleque. In charge of the water supply for the convent and nearby town, he was confronted by the problem of bringing the supply a distance of 40 miles, and across several arroyos. Before he was assigned to this work, when he first came to the convent, like the other friars, he learned the language of the natives. Then, being given the task of bringing water to the convent, he investigated the available supply in the area. In building his canal he surveyed the country and followed the hillsides except for three great stretches of aqueduct, in the construction of which he spent many years. One stretch is made up of 13 arches, another of 47, and the longest of 67. The largest of the arches are 8 ft thick and have a maximum height of 120 ft above the bed of the arroyo. The longest stretch of aqueduct took almost five years to build, during which Padre Francisco de Tembleque also erected a shed and a shrine, the first for use in directing the work and the second for use in preaching to his workmen. The magnitude of the work has been proclaimed by various writers in the intervening centuries. Lucas Alaman, a famous Mexican statesman and historian of the second quarter of the nineteenth century, in referring to the clear span of the main arch, stated that "a war boat with all its sails unfurled might easily pass under it."

FLOOD CONTROL IN THE VALLEY OF MEXICO

The troubles the Aztecs had from the flooding of their capital city have already been mentioned and so has the flood of 1449. The danger continued during the earlier Spanish Colonial period. There was a flood in 1580, and another at the turn of the century in 1604, which devastated the capital of the Viceroys. It was then (1607) that the engineer, Enrico Martinez, proposed the tunnel and cut at Nochistongo—a notable example of clear thinking in terms of projects of great magnitude. This cut connected the closed watershed in which Mexico City is located with the higher reaches of the Panuco River watershed, thus establishing the basis for the drainage of the Valley of Mexico and the prevention of floods in the capital city. This plan, with slight variations, has been followed through the centuries and still forms the foundation for the modern treatment of the problem.

In the trying times through which we are now passing, it is an inspiration to look back four centuries to the great undertakings of brave men who labored without any of the technical and mechanical facilities we now have. It is not during the easy periods of life, but when aims are high and effort intense, that great things are accomplished.

This brief review of sixteenth century accomplishments in water supply shows that the tradition back of Latin American engineering is a sound one, and constitutes a firm foundation for beneficial cooperation with the engineers of the United States, who, though they may be of different origin, are striving for the same goal of developing the resources of America.



Artificial Lake of Yuriria as Seen from the Convent

Effects of Channel Shape on Losses in a Canal Bend

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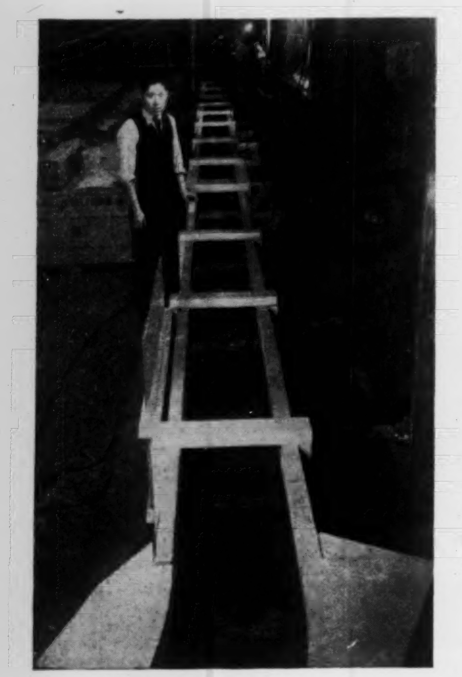


DISCHARGE CHANNEL OF THE MODEL

CANAL bends have not received as much attention as have other causes of head loss since bend loss is usually but a small part of the total loss in a canal. However, a better knowledge of bend losses is desirable for more economical operation.

The loss of head in a bend may be affected by such factors as radius of curvature, width, velocity, velocity distribution in the approach channel, hydraulic radius, roughness of channel walls, density and viscosity of the fluid, and the shape of the channel. Of these the shape factors, which were the subject of the experiments here recorded, play an important part. Most of these tests were at subcritical velocities.

Experimental data on the effect of shape modifications upon losses in a rectangular bend of fixed radius and deflection angle were secured for the following conditions: walls moved (1) outward and (2) inward from center line of bend; outer wall moved (3) inward and (4) outward; inner wall moved (5) toward and (6) away from center line; and bottom gradually (7) lowered and (8) raised, keeping width inversely proportional to depth for a particular discharge.

The loss of energy in the bend, in excess of that required for flow through an equal length of straight channel, represents the energy destroyed by velocity disturbances induced by the bend. The loss of head observed in the bend comes mainly from three sources: (1) internal friction of the induced or secondary current in and downstream from the bend; (2) reduction in effective cross-sectional area due to the space taken up by eddies accompanying the separation of the flow from the wall; (3) head loss due to repeated acceleration and retardation of water particles undergoing rapid velocity changes.

The experimental work was done in a 10 by 11-in. channel having a 2 by 4-ft entrance section 2 ft deep, a straight approach channel 24 ft long, a 90° bend, and a straight discharge section 48 ft long. The entrance section was provided with baffles and smooth rounded corners which created a practically uniform velocity distribution in the approach channel. Surface baffles were installed in and near the entrance of the approach channel to eliminate water-surface fluctuation. A tailgate was attached to the outlet end of the discharge tangent for regulating the depth of flow in the flume.

For measuring the elevation of the water surface and the friction losses in the channel, 6 floor piezometer openings were made in the approach tangent, 13 in the discharge tangent, and 21 in the bend. One piezometer opening was placed on the center line of the flume at each section, and others were placed symmetrically about the center line at those sections where three or five openings were used. For each run a complete set of readings was obtained on all piezometers. All air was excluded from the various lines connecting the piezometer tube.

The discharge was determined by measuring the head on the V-notch weir with a hook gage at the beginning of a test and at least twice during the test. The formula of the rating curve was found to be $Q = 2.52H^{2.55}$.

After a given flow was established, approximately 20 to 30 minutes was allowed for conditions to stabilize before measurements were taken. Depths of water at different sections were determined first by point gage. Velocity measurements were taken at 25 different points at each section so that the velocity contours could be drawn, a pitot tube being used for this purpose. In measuring velocities on the tangents, the velocity orifice was pointed directly upstream. In the bend, the velocity orifice was held normal to the cross section at which measurements were being taken.

A short thread was attached to the lower end of the pitot tube. The deflection of this thread from the normal line to the sections was read from above by a protractor. At the same time a small spiral-flow detector was used to give the magnitude of secondary currents, roughly shown by the rate of revolution of the small blade.

Three different methods were used for measuring the head loss in the bend:

1. A station 15 ft upstream from the beginning of the bend and a station 35 ft below the end section of the bend were used as reference points. All calculations were based on the losses between these two stations of the flume, thus eliminating the effect of disturbing conditions in the approach and discharge channels. The measured loss minus the loss in a straight channel having a length equal to the distance between the two stations was taken as the loss due to the bend.
2. Since the channel had the same characteristics throughout its entire length, the loss of head in the bend could be obtained by determining the hydraulic gradient for the channel for some distance above and below the bend. If there were no disturbances, the two hydraulic gradients would be parallel and the gradient downstream from the bend would lie in a lower position than the gradient upstream from the bend. The vertical difference between these gradients was the actual loss due to the bend.
3. Specific energy gradients were used. The vertical difference between the average total head gradient above and below the bend was taken as the loss of head caused by the bend.

The essential changes in head loss characteristics due to shape modification are indicated in Table I. A fuller description of flow characteristics in each case follows:

(*a*) Normal bend having a 5-ft radius of curvature and an 11-in. width. The head losses in this bend were made the basis of comparison in considering the head losses in other bends; hence this was called a "normal bend."

(*b*) Narrow bend. Both walls shifted toward the center line of the channel. The velocity of the flow at the end of the section of the bend was above the critical velocity, a standing wave forming 10 or 15 ft downstream from the bend. The head loss in the bend was increased about 400% for various discharges as compared with that of the normal bend.

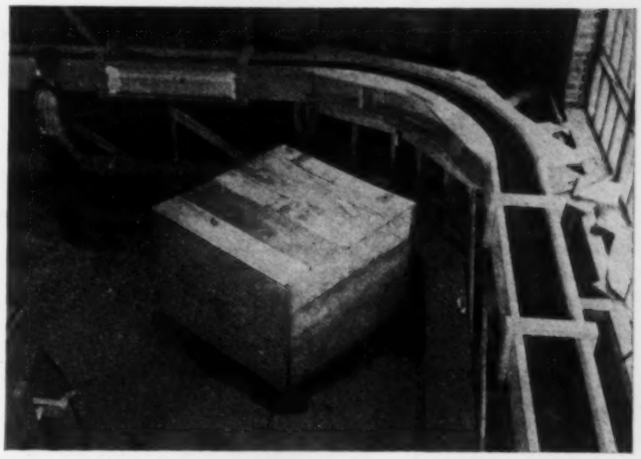
(*c*) Narrow bend with bottom lowered to compensate for narrowing of the width. One bottom elevation was good only for a certain quantity of flow. In this case the bottom was designed for Q = 0.950 cu ft per sec. For this flow the bend loss was 11.0% less than that of the normal bend. It is believed this reduction in loss is due to reduction in the strength of secondary currents in the narrower bend. As the discharge decreased the desirable effect rapidly diminished.

(*d*) Wide bend—both walls shifted outward from the center line of the channel and the width of the channel at the middle section of the bend increased 30% of the original width. The maximum improvement was 7.5%. In this case, the strength of the secondary currents was increased by decreasing the b/d (d = depth of flow, b = width of channel) ratio in the bend, but the eddies and whirls in the separation zone around the inner walls were reduced in a much greater proportion by reduction in the rate of change in direction of flow around the inner wall. Moving the outer wall outward not only caused a wavy flow around the bend but also increased the head loss. This conclusion is verified and explained later.

(*e*) Wide bend with bottom raised to keep the cross-sectional area constant. The bottom was designed for Q = 0.950 cu ft per sec and the result was practically the same as for the wide bend with level bottom except that the flow condition was much smoother. The bottom when used for other quantities of flow was not as efficient (Table I, ***e***).

(*f*) Outer wall shifted toward the center line of the normal bend. The loss of head was increased about 100% for various discharges, the rapidly accelerated flow around the bend producing a standing wave downstream and thus causing greater loss.

(*g*) Outer wall shifted outward from the center line of the normal bend. The head loss was increased from 2.2% to 18.0% for Q = 0.950 cu ft per sec and Q = 0.380 cu ft per sec respectively, since the rate of change in direction of flow was increased by shifting the outer wall outward, and the strength of the secondary current was also increased by decreasing the d/b ratio around the bend. This was especially true for low, shallow flows.



Model of Channel Bend and Manometer Bank

(*h*) Inner wall was shifted toward the center line of the normal bend. The head loss in the bend was increased by about 100% for various discharges for two reasons: (1) A standing wave formed in the downstream channel owing to the rapidly accelerated flow through the narrow section. (2) The rate of change in direction of flow was increased at the midpoint of the bend, thus causing eddies and whirls.

(*i*) Inner wall shifted outward from the center line of the normal bend. This modification improved the efficiency of the bend by 10%. It also showed consistent improvement for various discharges. The improvement can be credited to the reduction in the rate of change in direction of flow in the central part of the bend, with consequent narrowing of the separation zone with its accompanying eddies, whirls, and internal friction.

The analysis of the data leads to the following conclusions:

1. Loss of head through a rectangular channel bend can be reduced either by (*a*) shifting the inner wall away from the center line of the channel, or (*b*) by narrowing the width of the channel and increasing the depth to provide constant cross-sectional area for a given discharge.

2. If it is desired to keep the loss of head to a minimum, then under no conditions should the width of the channel around the bend be narrowed by shifting the outer wall or the inner wall toward the center line of the channel without lowering the bottom sufficiently to compensate for the loss in cross-sectional area.

3. The head loss in the experimental 90° bend with uniform width of 11 in. and 5-ft radius of curvature was found to follow the empirical formula,

$$H_b = 0.380 \frac{V^2}{2g}, \text{ in which}$$

H_b = head lost in the bend in ft

V = mean velocity in approach channel in ft per sec

g = acceleration of gravity in ft per sec^2

Maximum deviation from this equation was 10%.

This investigation was undertaken by the junior author in partial fulfilment of the requirements for the degree of Doctor of Philosophy in the Department of Mechanics and Hydraulics of the State University of Iowa under the direction of the senior author.

Table I. Summary of Experimental Data—Flows in Cu Ft per Sec.

	Width at Middle Section of Bend		Head Loss in Bend							
			Flow, 0.95		Flow, 0.77		Flow, 0.62		Flow, 0.38	
Description of Model Bend	In.	% Increase or Decrease	Ft	% Increase or Decrease	Ft	% Increase or Decrease	Ft	% Increase or Decrease	Ft	% Increase or Decrease
(*a*) Normal bend with 5-ft radius of curvature	11.00	0	0.038	0	0.033	0	0.031	0	0.028	0
(*b*) Both walls shifted toward center line of channel	7.70	−30	0.188	+ 400	0.167	+400	0.156	+406	0.137	+385
(*c*) Same as (b) with bottom curved down	7.70	−30	0.033	−11.0	0.032	−7.5	0.032	+2.7	0.060	+112
(*d*) Both walls shifted outward from center line of channel	14.30	+30	0.036	− 4.5	0.031	−7.5	0.030	−2.7	0.036	+ 26
(*e*) Same as (d) with bottom curved up	14.30	+30	0.036	− 4.5	0.032	−5.0	....	...	....	...
(*f*) Outer wall shifted toward center line of channel	9.35	−15	0.072	+93.0	0.068	+105	0.066	+116	0.062	+118
(*g*) Outer wall shifted outward from center line of channel	12.65	+15	0.038	+ 2.2	0.036	+7.5	0.035	+13.5	0.033	+18.0
(*h* Innerwall shifted toward center line of channel	9.35	−15	0.071	+89.0	0.068	+103	0.066	+113	0.061	+115
(*i*) Inner wall shifted outward from center line of channel	12.65	+15	0.034	− 9.0	0.030	−10.0	0.028	−8.0	0.032	−6.0

Advances in Engineering Seismology

From a Report on the Work of the U.S. Coast and Geodetic Survey Prepared for Joint Committee

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ONLY during the last decade have engineers had basic data on strong earth motions to aid them in the design of structures. Translation of the results into practical applications is still new. In 1925 seismological investigation on behalf of the federal government was assigned to the Coast and Geodetic Survey. In 1929 the late John R. Freeman, Past-President and Honorary Member of the Society, while in Japan became impressed with the work of the Earthquake Research Institute, and his advocacy of similar work in the United States aroused interest. One result of this was a Congressional appropriation of funds to the Coast and Geodetic Survey, which made possible the program of earthquake investigation here outlined. This paper is based on the report prepared by Capt. Heck for the Joint Committee on Seismology of the Society's Soil Mechanics and Foundations Division.

IN its program of strong-motion earthquake investigation inaugurated in 1932, the U.S. Coast and Geodetic Survey installed a number of strong-motion instruments. The first data secured were for the Long Beach earthquake of March 10, 1933. The program later included measurement of the vibration periods of structures and of the ground, study of earthquake damage, and investigation of the possibility of partial earthquake prediction.

Strong-motion instruments, by whatever name they are called, are insensitive seismographs. Their special characteristic is that the earthquake itself actuates a pendulum device, automatically setting the recorder in operation for about a minute. The recorder then stops unless the earthquake continues. There are time marks at half-second intervals but no absolute time. Instruments in the same building are connected so as to have simultaneous time marks. This practice makes it possible to secure such a comparison as that shown in Fig. 1. The recording is photographic unless otherwise stated. The operation is wholly automatic, inspection being made once a month. There are three general types of strong-motion instruments in use by the Coast and Geodetic Survey:

1. *Accelerographs.* Each accelerograph consists of three accelerometers at right angles to each other in XYZ axes, and the necessary optical, starting, and time-marking devices. Each accelerometer has a suspension, consisting of a slender shaft, with a pivot at each end, mounted in jeweled cups. The steady mass is a rectangular loop attached to the shaft and its motion is damped by a strong magnet. A helical spring provides the restoring force after disturbance and also a ready means of adjustment.

The name "accelerometer" is used because when the natural period of the seismograph (in this case 0.1 sec) is small compared with the periods of earthquake waves believed to be dangerous (0.3 to 2.5 sec), the amplitudes on the records are proportional to the accelerations. Through a special optical device there can be two magnifications, making it possible to record the full known range of acceleration in destructive earthquakes (perhaps $0.03g$ to $0.6g$ or even g) provided the instrument survives. With this arrangement a continuous sheet of photographic paper 12 in. wide is used. With base lines, two magnifications, and time marks, there are 12 lines on the records.

2. *Displacement Meters.* These resemble seismographs of the older horizontal pendulum type. They are so named because, with a period of about 10 sec, large in comparison with the destructive range, they record oscillatory displacement directly. Their equipment is similar to that of the accelerograph, except that no vertical instrument has been developed. Special precautions are taken to keep the boom from swinging away from the supporting column, as a quick return would injure the pivot.

3. *Weed Strong-Motion Instrument.* This is a visual recording instrument using a smoked-glass plate. It is less useful than the others because it is difficult to interpret the records in physical units.

Of the 60 strong-motion instruments installed by the Coast and Geodetic Survey, 43 are accelerographs, 6 displacement meters, and 11 Weed instruments. All these are in California except for 10 of the accelerographs, of which 4 are in Nevada (3 belonging to the U.S. Bureau of Reclamation), 4 in Montana, 1 in Utah, and 1 in the Panama Canal Zone.

The California installations are widely scattered but the majority are in metropolitan areas. Following the advice of engineers, they are placed in many different locations and groupings, such as several in a building at different heights, on city ground away from tall buildings, on a bridge pier, and on a variety of geological formations. (See Fig. 2 and a group of photographs.) Of the 60 instruments, 47 have given records, and it is only a matter of time before the others will.

From January 1, 1933, to November 30, 1941, there have been 271 strong-motion records of 103 earthquakes (from 5 to 26 earthquakes per year), of which 70 were in California. In 22, there were simultaneous records at the same site on both accelerographs and displacement meters.

The number of records obtained is directly related to the sensitivity of the starter. It is now agreed that too

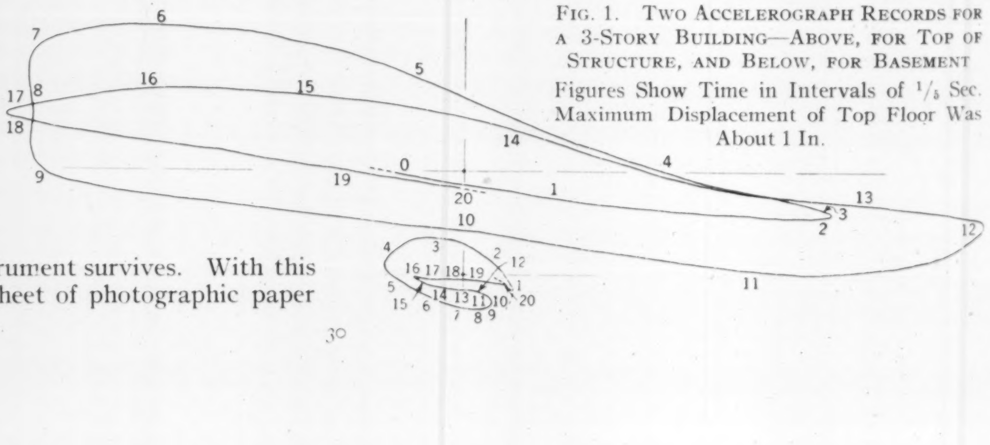
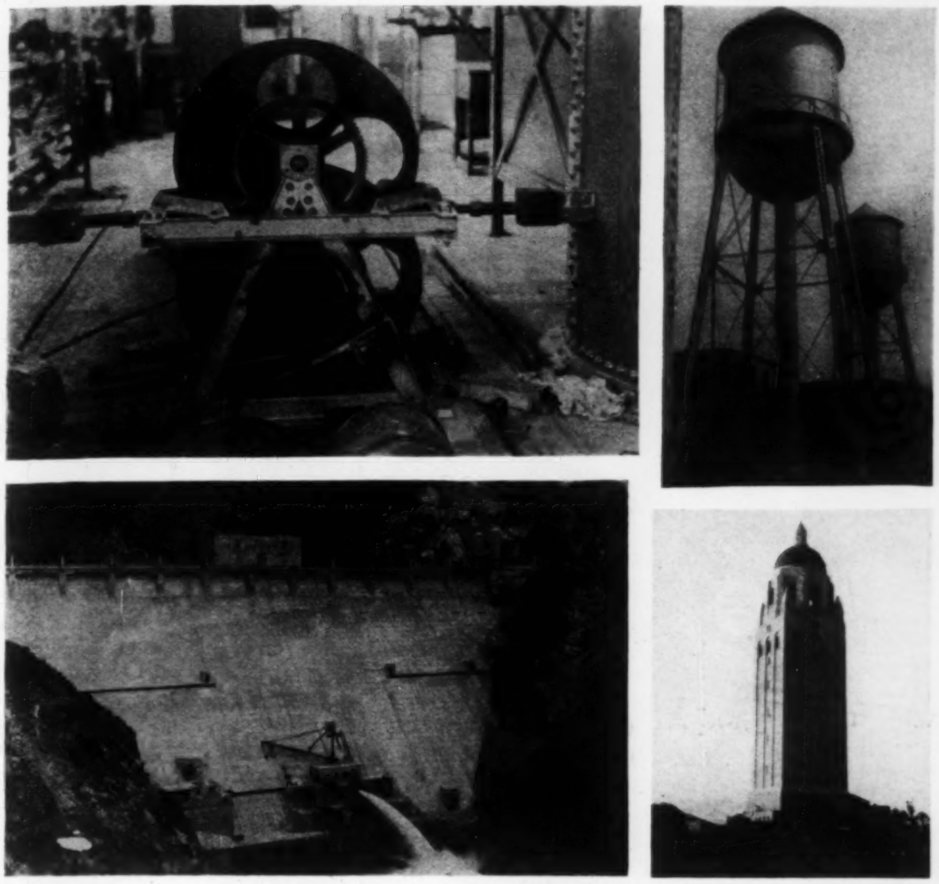


FIG. 1. TWO ACCELEROGRAPH RECORDS FOR A 3-STORY BUILDING—ABOVE, FOR TOP OF STRUCTURE, AND BELOW, FOR BASEMENT

Figures Show Time in Intervals of $^1/_5$ Sec. Maximum Displacement of Top Floor Was About 1 In.



Structures on Which Vibration Observations Have Been Made

Building Vibrator; Tank Typical of Many on Which Observations Were Made; Large Dam; and Tower Building Tested Periodically During Construction

many slightly destructive earthquakes have been recorded, and less sensitivity is being adopted. In some cases this has always been necessary to avoid starting by non-seismic causes.

The information given directly or indirectly by the strong-motion records includes acceleration, velocity, ground displacement (oscillatory), and periods, all referring to the motion of the ground particle at the place of observation. Since accelerographs are more numerous and widespread, the derivation of velocity and displacement from the acceleration is especially important. This is accomplished by integration, although the integration of a complex earthquake record is not simple. In the method developed by the Coast and Geodetic Survey, the accelerogram is enlarged as much as 25 times horizontally and $2^{1}/_{2}$ times vertically. Mean ordinates are then measured from the base line on the record for approximately each 0.04 sec. The integration is by computing machine. By a series of adjustments, mathematical axes are found for each curve. The requirement is that the displacement curve represents an approximately symmetrical oscillatory motion about a central axis. To date, the principal strong-motion records are for the following five earthquakes, summarized in Table I:

1. The Long Beach earthquake of March 10, 1933, as recorded at Long Beach, Vernon, and Los Angeles, respectively about 19, 32, and 38 miles from the adopted epicenter. These are potentially the most valuable records to date but absence of recent instrumental improvements prevents their full utilization. Short-period, high acceleration waves at the start introduced uncertainties in the interpretation of the Long Beach records, and the curves of different accelerometers sometimes overlapped and were hard to separate. However, the computed displacement at Los Angeles has been used to control the motions of shaking platforms utilized to test models of structures at the Massachusetts and California institutes of technology and at Stanford University.

2. The Helena, Mont., earthquake of October 31, 1935, as recorded at Helena (Fig. 3). This is the most important of the series recorded. It was probably a shallow-focus earthquake in a region with moderate depth of sediments although it was locally highly destructive.

3. The Imperial Valley earthquake of December 30, 1934, as recorded at El Centro, 50 miles from the epicenter. This record is difficult to analyze and the derived motions in Table I are somewhat uncertain.

4. The Imperial Valley earthquake of May 18, 1940, as recorded at El Centro, 7 miles from the epicenter. There was surface slipping along a fault for 50 miles, a maximum of 12 ft. near the Mexican border, 13 miles from El Centro. This record is very informative. It also gives data useful to the seismologist regarding the start of earthquake waves. (See Fig. 4. A shaking platform on which models of structures are tested could be constrained to follow the principal motions of this diagram and so simulate an actual earthquake.)

5. The submarine earthquake of June 30, 1941, off Santa Barbara, as recorded at Santa Barbara, 10 miles from the epicenter. Damage was chiefly to underground pipes.

Table I. Principal Strong-Motion Records

		Maximum Motions				
		Acceleration			Displacement in Cm	
Earthquakes	Where Recorded	Cm per Sec²	g	Velocity, Cm per Sec	Inspection*	Integration†
Long Beach	Long Beach	250	0.26	25	3.0	..
	Vernon	210	0.24	24	6	..
	Los Angeles	60	0.06	15	6	10
Imperial Valley, 1934	El Centro	175	0.18	7	..	...
Imperial Valley, 1940	El Centro	314	0.32	14	3	20
Montana	Helena	115	0.12	4	0.2	2.5
Santa Barbara	Santa Barbara	172	0.18	7	0.3	..

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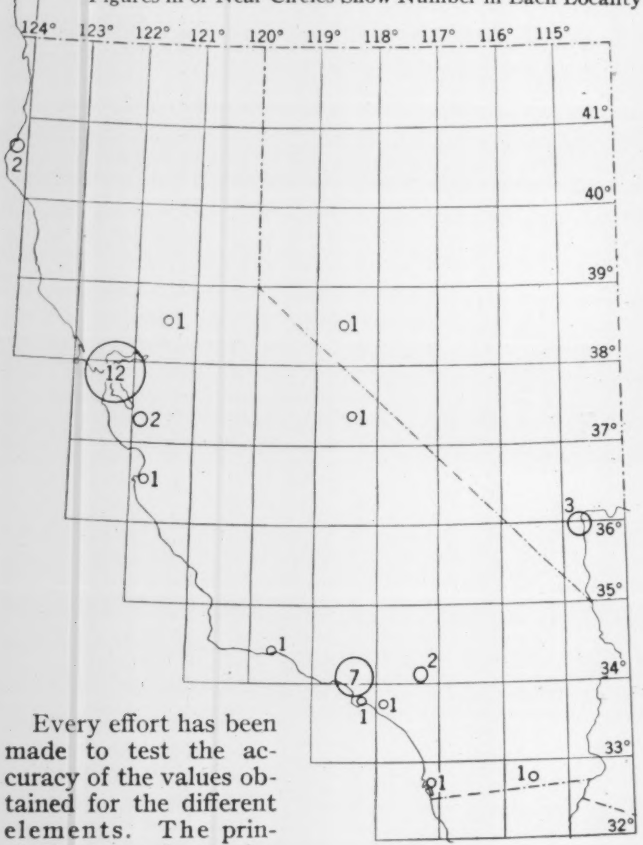
* Inspection refers to displacement by inspection, which is obtained from the accelerogram on the assumption of simple harmonic motion. It is approximately the maximum displacement associated with the periods which can be read directly on the record.

† The greater displacements shown in this column are associated with the longer periods brought out by integration and they approximate the true maxima.

FIG. 2. STRONG-MOTION SEISMOGRAPHS IN CALIFORNIA
Figures in or Near Circles Show Number in Each Locality



Every effort has been made to test the accuracy of the values obtained for the different elements. The principal tests have included: (1) shaking-table tests to determine the accuracy of accelerations, (2) an independent check of the validity of the mathematical methods, and (3) determination of displacement from both the accelerograph and the displacement meter in the same building, for the Northern California earthquake of December 20, 1940, recorded at Eureka. The results are generally satisfactory from the engineering viewpoint.

The relation of earthquake destructiveness to the elements of earth motion have not been fully established. The more important elements include acceleration, period, and duration (including accumulative effects of strong aftershocks). Much further study is needed.

Period can be important through resonance. If earthquake waves have outstanding periods, and these coincide with the periods of structures, the effects are greatly enhanced. There is evidence from Japan and Germany that there may be dominant periods. At Tokyo periods of 0.3–0.4 sec and 0.6–0.7 sec were established for the earthquake of September 1, 1923. Studies of a region near Göttingen gave periods of 0.3–0.4 and 1.2 sec.

Similar work has been done in California by studying the periods of earthquake waves recorded by seismographs and strong-motion instruments. Other studies have been made of artificial earthquake effects, such as are caused by explosions, traffic, machinery vibrations, and shaking machine, all recorded through suitable instruments by photographic methods. In the case of earthquakes, the records refer only to fixed places of observation and hence cover only a limited range of geological conditions. Also, it is necessary to wait until an earthquake occurs. With shaking machines, there is a wide range in choice of site, and observations can be made when desired. But since the period of the vibration is related to the thickness of the layer set in vibration, it is conceivable that not enough energy could be put into the ground to bring out the periods that might be dominant in a major earthquake.

Dr. B. Gutenberg of the Seismological Laboratory of the California Institute of Technology, in cooperation with the Coast and Geodetic Survey, has analyzed the periods of numerous records of the network of Southern California stations which are specially equipped to locate nearby earthquakes. Periods have been determined for most of the strong-motion records.

Determinations of the periods of the ground have been made by shaking machine, supplemented by other methods, at a number of sites in California. The shaking-machine method is preferable because the amount of energy put into the ground is known and can be controlled, and it is possible to vary the speed so that all resonance periods are developed.

It was necessary to develop both shaking machine and recording instruments. The shaking machine was designed to develop a force of 6,000 lb (range 2,000–10,000 lb) and it requires a heavy weight to hold it down. The chief recording instrument is the Neumann-Labarre vibration meter. (F. Neumann is with the Coast and Geodetic Survey, and R. V. Labarre, M. Am. Soc. C.E., is chairman of the Society's Joint Committee on Seismology.) This has magnifications up to 10,000. These are horizontal instruments. The Patterson or Coast and Geodetic Survey vibration meter measures vertical motion.

The results obtained by different methods in the same locality agree fairly well. The conclusion is that there are in California, at all places where observations have been made, a number of outstanding periods, but no truly dominant ones in the sense that structures could be designed to avoid them and thereby prevent danger from resonance. In one case in California the outstanding periods were, 0.67, 0.50, 0.39, 0.34, 0.29, and 0.17 sec.

Ground periods have engineering significance only in their relation to the periods of structures. It has sometimes been stated that the period of a simple structure is 0.1 sec for each 10 ft of its height. Actually, periods of tall structures and of structures of irregular cross section do not follow this rule; periods are different in different directions, and they vary with details of construction as well as with height. The only satisfactory method is direct measurement. Wind or traffic may set up resonance but the use of a small shaking machine is preferable. The recording apparatus consists of vibration meters

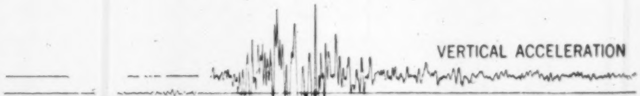
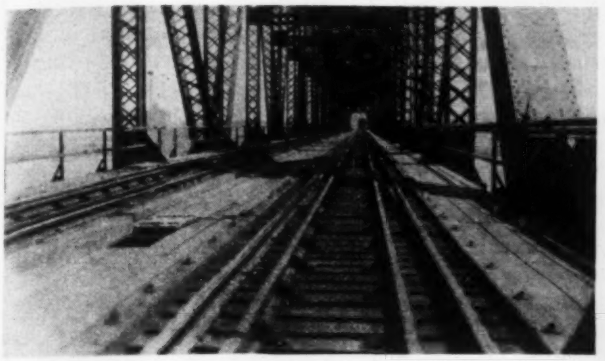
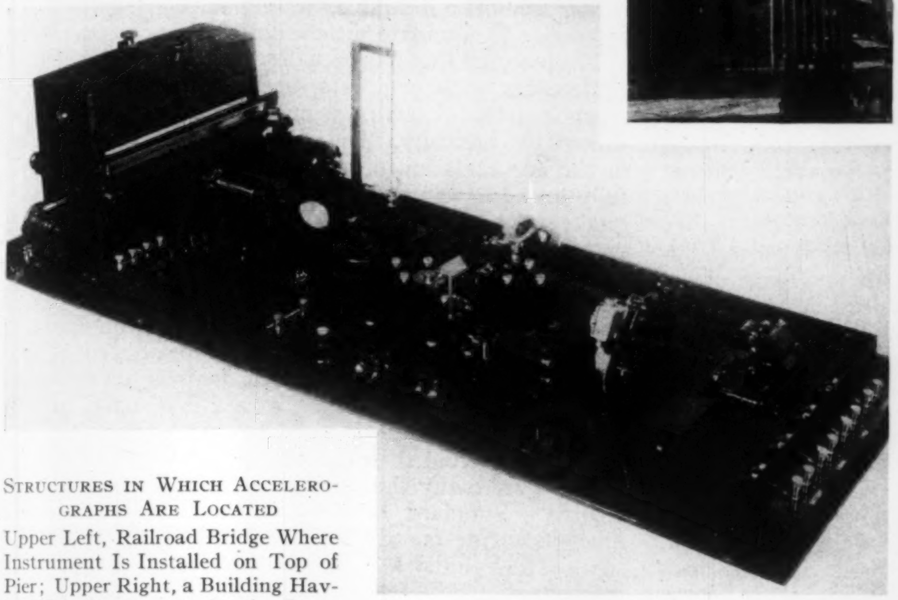


FIG. 3. THREE COMPONENTS OF ACCELEROGRAPH RECORD OF HELENA, MONT., EARTHQUAKE
Small Records to Left Are Small Independent Earthquakes





Structures in Which Accelerographs Are Located

Upper Left, Railroad Bridge Where Instrument Is Installed on Top of Pier; Upper Right, a Building Having One Instrument in the Basement and Another on the Thirteenth Floor; and Below, a View of the Accelerograph Itself

using the principle of the Wood Anderson torsion seismometer. Photographic recording has been generally adopted. The problems are simpler than in ground vibration and the resonance pattern is much sharper. Structures on which shaking-machine studies have been made are shown in an accompanying group of photographs.

Determination of periods of large dams, bridges, and other complex structures may require methods intermediate between those used for structures and for the ground.

It has recently become the practice to make systematic observations of the periods of a building under construction, repeating them at intervals until it is finished. Notable examples include the Hoover Library at Stanford University and the new Appraisers Building in San Francisco.

Vibration observations have been made in about 360 buildings in California and 7 in Montana, in some cases at a number of places in the same building. In addition, observations have been made on six bridges, three great dams, one tall stack, and a number of tall tanks.

Most building codes take account of earthquake risk by requiring that the building shall be able to resist a horizontal acceleration of some fraction of gravity, as for example, one-tenth. This method has been remarkably effective and should not be lightly abandoned, but the results should be tested as opportunity permits by studying recorded earthquake motions. Problems of design can be solved by testing building models on platforms constrained to follow actual earthquake motions. The strong-motion records can be used to predict stresses in structures by means of a torsion pendulum analyzer. This has been done at several engineering institutions.

The vibration measurements give information about buildings which is useful in connection with resonance problems, and which also makes it possible to remeasure periods after a damaging quake to detect changes that may affect the safety of the building.

The oldest attack on the problem, which is still useful, is the collection of information from eyewitnesses immediately after an earthquake has occurred. This was the chief method used by engineers in the United States until recently, and if the results are properly evaluated, it is an effective one. The Coast and Geodetic Survey, with the aid of cooperating agencies, collects and publishes information for the entire United States and other areas under its jurisdiction.

In the western part of the United States there is a collaborator in each state who is responsible for earthquake reports within his state. The system is effective except as regards the engineer's main interest—the collection of detailed engineering information closely related to design, although photographs in part supply this lack.

After the Long Beach earthquake, a comprehensive study of certain types of buildings was made with the cooperation of the California Institute of Technology, but ordinarily only general information is obtained. The personnel of the Coast and Geodetic Survey engaged in this work is small and includes no structural engineers. Besides, after any important earthquake, they are fully occupied with other parts of the program. It is only reasonable that structural engineering agencies should untertake this work. One difficulty is that the emergency comes suddenly, and when it comes most engineers have more than they can do preparing rush plans for reconstruction.

The Coast and Geodetic Survey holds the view that the prediction of earthquakes in time, place, and maximum intensity—the only very useful kind—is impossible for the present at least. However, it holds the engineering view that since the earth is composed of structural materials and an earthquake resembles in some degree the failure of materials in a testing machine, it should not be impossible to detect increasing strain which indicates danger of an earthquake. Tests can only be made in a region where slipping has occurred along an exposed fault. Three methods have been used by the Coast and Geodetic Survey—geodetic measurements, tilt measurements, and seismic acoustic investigations, as described in the following paragraphs.

Geodetic Measurements. According to the elastic-rebound theory of Harry Fielding Reid, the immediate cause of an earthquake is a sudden release of elastic strain. This should be indicated by movements in op-

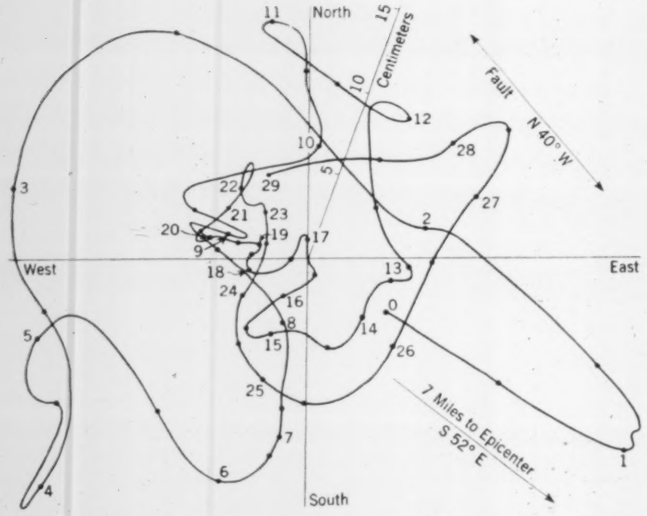


FIG. 4. GRAPH OF HORIZONTAL MOTION OF INSTRUMENT PIER AT EL CENTRO DURING IMPERIAL VALLEY EARTHQUAKE OF MAY 1940, COMPUTED FROM SEISMOGRAPH RECORD

Covers Period of 29 Successive Seconds (See Numbers)

posite directions of points on opposite sides of a fault. Such movements can be detected only by geodetic measurements repeated at intervals. Such periodic measurements have been made in California but it is too early to discuss results.

Tilt Measurements. It has been established that in some cases in Japan there has been slow tilting and then a large and readily perceptible tilt a few hours before a great earthquake. Such occurrences are probably associated with the movement of blocks of the earth's crust. In California the slipping has been predominantly horizontal and the likelihood of tilt is uncertain. Measurements have been made continuously since May 1933 on the Haywards Fault by the Coast and Geodetic Survey and the University of California. As earthquake activity has been slight and there are a number of nonseismic causes of tilt, the results have been inconclusive.

Seismic Acoustic Work. This type of investigation is based on the idea that before an important slip, the great pressure would cause minor slips which would produce noises; such sounds, though detectible on a near-by microphone, would have no effect even on a sensitive seismograph several miles away. The theory has been tested by continuous observation at Oakland on the Haywards Fault. Again the results are not conclusive, although unexplained variations in the noise level were observed. Hydrophones in deep wells were used with photographic recording. Further tests in a more active region would be desirable, accompanied by surface observations to eliminate surface noises from consideration.

The program that has been described was adopted after conferences with engineers, architects, geologists, and seismologists. It has been modified from time to time, though not basically. The value of the work to date lies in the accumulation of a mass of observed data, carefully tested to assure its validity. Now when an earthquake occurs, it is possible to correlate observed damage with known intensity.

One result of these observations is the reproduction of actual earthquake motions on a shaking platform to test models of structures. The observation of building periods makes it possible to study resonance effects. Measurement of ground vibration periods have demonstrated that earthquakes do not have one or two periods so dominant that safety could be secured by designing buildings to avoid these periods.

There are many things to be done in interpreting the records. Standard building codes treat earthquakes much as engineers ordinarily treat wind pressure and design. The validity and limitations of such approximate methods should be further analyzed. The program that has been discussed is not likely to be greatly increased, but there is room for better utilization of results.

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Analyzing the Degree of Randomness in Weather Data

By R. EVAN KENNEDY, JUN. AM. SOC. C.E.

STRUCTURAL DRAFTSMAN, AMERICAN BRIDGE COMPANY, TRENTON, N.J.

CONCERN over the recent drought and rise of mean annual temperature throughout the western Great Plains area has been based upon the 10-year running average method for visualizing trends in temperature, evaporation, and related hydrologic phenomena. However, it is frequently true that this running average method would reveal trends from purely random data as good as those from the weather data interpreted as cyclic.

While the writer was with the Colorado Water Conservation Board in Denver, he was assigned the task of finding a statistical procedure which would reveal to what extent mathematically acceptable cycles existed in the weather data used by George S. Knapp, M. Am. Soc. C.E., in his survey of Great Plains cyclic trends. (See his article, "Water Resources of the Mid-Continent Area," CIVIL ENGINEERING for October 1940.) An article by R. E. Horton, M. Am. Soc. C.E. ("Group Distribution and Periodicity of Annual Rainfall Amounts," *Monthly Weather Review*, October 1923) suggested the method to be used in this study. Mr. Horton worked out this method independently but found later that it was used as far back as 1881. It requires no plotting, no computation of the standard deviation, and can be applied quickly to any data for which a mean value has been obtained.

The writer's study, based on Mr. Horton's method, was concluded with a report rendered in January 1941. It showed that all but one of the records used by Mr. Knapp were still random in spite of the recent drought years. The only station in the entire region showing an uncertainty which could be interpreted as cyclic by those looking for cycles was the long one at St. Paul, Minn. This record fits the pure-chance distribution curve very poorly because of the presence of 15 consecutive years of temperatures below the mean in the early part of the record. Scientists of that day, using the running average method, would have been apprehensive lest they were heading straight for another ice age.

The long record at St. Louis, Mo., on the other hand, conforms closely to a random distribution curve. The recent warm years above the mean are not numerous enough to distort the fit, but that station should have in the immediate future some years of subnormal temperatures or it will be departing appreciably from its century of randomness.

Reference has been made to random distribution curves. They were employed merely as a check on the method used. As a means of explaining the method itself, it will be applied to the case in hand. All years above the mean are simply classified as warm, and all below as cool, regardless of how warm or how cool they may have been. The magnitude of the departure of any particular year from the mean is adequately accounted for in its effect on the mean.

The consecutive years on the same side of the line, whether above or below, are counted as groups, regardless of how many years are in the group. One year may be a group; the only criterion is that it must be preceded and followed by at least one year of opposite sign.

The total number of groups and the total number of years in the record are the only two functions in the formula. If m = total number of years of record, and G = total number of groups of like events in the record, then the ratio of m to twice the number of groups, or $2G$, is unity for pure randomness, or $\frac{m}{2G} = 1$. This is a measure of randomness.

The following values were found for stations in the mid-continent area divided into regions:

Northern	1.09
Central	1.04
Southern	1.11

Some individual stations were: St. Louis, Mo., 1.09 for a record of 103 years; St. Paul, Minn., 1.43 for a 120-year record. Out of the region was Albany, N.Y., 1.20 for 114 years, and New Haven, Conn., 1.51 for 160 years of record. The list need not be extended here since any published weather record can be examined, the groups above and below the mean quickly counted, and the departure from pure randomness, if any, determined. Short records are of course less reliable.

At least two questions immediately arise: What is the mathematical background that sustains such a simple procedure, and how can this coefficient of randomness be evaluated?

The usual illustration employed in a discussion of this kind is tossing a coin for heads or tails or drawing white or black balls from an urn. Before the first ball is drawn the chances of its being white are 1 to 2, or expressed as a fraction, one-half. The chance of being able to predict that the first two balls will be of any one color before any drawings have been made is 1 to 4. It follows the well-known probability theorem, $P = m(^1/_2)^{n+1}$ in which n is the number of like events in a period of m events.

Thus the probability of two warm years being followed by a cold year, or vice versa, is $m(^1/_2)^3$ or once in 8 years in random data. This does not necessarily mean once every 8 years, but an average through a long span of years, say 1,000 years, with an unknown and unknowable number of years occurring between. "Once in so many years" is a convenient phrase when its meaning is understood. In this same 1,000 years, there will occur other groups of warm or cool years, groups of 4 years, 5 years, and so on, each preceded and followed by at least 1 year of opposite sign.

This situation is shown in tabular form in Table I.

TABLE I. PROBABILITY OF RECURRENCE OF GROUPS OF LIKE EVENTS IN A PERIOD OF 1,000 EVENTS

n = NUMBER OF LIKE EVENTS IN A GROUP	PROBABILITY OF OCCURRENCE $P = (^1/_2)^{n+1}$	NUMBER OF TIMES THE GROUP WILL OCCUR IN 1,000 EVENTS
1	$^1/_4$	250.00
2	$^1/_8$	125.00
3	$^1/_{16}$	62.50
4	$^1/_{32}$	31.25
5	$^1/_{64}$	15.62
6	$^1/_{128}$	7.86
7	$^1/_{256}$	3.93
Total	About $^1/_2$	496.16

It is readily seen that Col. 3 is nearly the decimal equivalent per 1,000 events of Col. 2, and that in this 1,000 events or years there occurred about 500 groups of consecutive like events ranging from 1 to 7 years. Of course an 8-year group might come in, for it has a chance of occurring once in 512 years. For that matter, a 15-year group with a chance of occurrence of once in 65,000 years did happen in the St. Paul record.

The length of the group has no bearing on this particular phase of the problem. It is the number of times it is apt to happen in the period, 1,000 years in this case. The important thing to note is that there are about $^1/_2$ as many groups in this 1,000 years as there are years. In fact the answer is just $^1/_2$ for an unlimited number of purely random events. In textbooks on mathematics a common problem is to show that the sum of the probabilities in such a series as Col. 2 approaches $^1/_2$ as a limit as n in Col. 1 increases without limit.

Then the total number of groups, G, regardless of size, divided by the total number of years of record, m, equals one-half, or $\frac{G}{m} = \frac{1}{2}$. Transposing, $\frac{m}{2G} = 1$, or unity for pure randomness. This is the criterion of randomness used.

A good way to visualize this is to toss a coin and record the results. Mr. Horton tossed a coin 2,000 times in two series of 1,000 tossings each. His results compare favorably with the theoretical results in Table I. His largest group comprised 10 like events in one of his 1,000-event series. According to theory, that would happen on an average of once in about 2,000 events. In this case it did happen in just 2,000 events. His coefficient of randomness was 1.02.

The question as to how far above unity this coefficient of randomness may go before it becomes a coefficient of periodicity, as Horton prefers to call it, is not so easily answered. Mr. Horton states that if the data are purely cyclic and free from any chance variation, this coefficient will be just $^1/_4$ the length of the cycle. The 11.3-year sunspot cycle is generally accepted as being nearly periodic. Applying this method to 183 years of record, a coefficient of periodicity of 2.68 was obtained, which would mean a cycle of 10.7 years if the data were purely cyclic and the record very long. This is interesting, but to have a bearing on the problem a correlation between mean annual temperature and the sunspot cycle should be obtained.

A means was found for evaluating the coefficient of randomness in the χ^2 test, or the test for goodness of fit. This is a long and tedious computation involving the standard deviation, and the full value of the departure of each event from the mean. It is described in several texts on statistical analysis, and will merely be outlined here. Known random data plots up into a definite mathematical curve. Matching this curve to the curve of the test data gives a basis for comparing the two. The conclusion was reached that the coefficient of randomness is a simplified χ^2 test, and that a coefficient below 1.35 indicates that there is no reason to suspect that the data departs from randomness. It is not a sharp division line at 1.35, but rather a general region or zone.

Higher coefficients "strongly indicate that the hypothesis fails to account for the whole of the facts," as Fisher says of the corresponding χ^2 test. Randomness may not account for them, but what does account for them is not indicated.

Since man is functionally rhythmic, it is very natural for him to look for cycles. It is common belief that back of it all there must be wheels within wheels that run the thing, so to speak, and that apparent randomness is only the exposed segments of certain wheels going into phase and then out of phase with segments of other wheels that come into view and then recede. This may be true, but in general the records available to us at present are much too short to determine our location on these long swings when the many wheels may be in or out of phase.

The writer wishes to thank C. L. Patterson, chief engineer of the Colorado Water Conservation Board, for releasing this study for whatever value it may prove to have, and also to tender acknowledgments to his father, Robert E. Kennedy, M. Am. Soc. C.E., for invaluable suggestions. He also recognizes, with many others, his debt to R. E. Horton, one of the pioneers in hydrologic thought.

Rubble Masonry for Road Culverts and Retaining Walls

By L. M. WINSOR, M. AM. SOC. C.E.

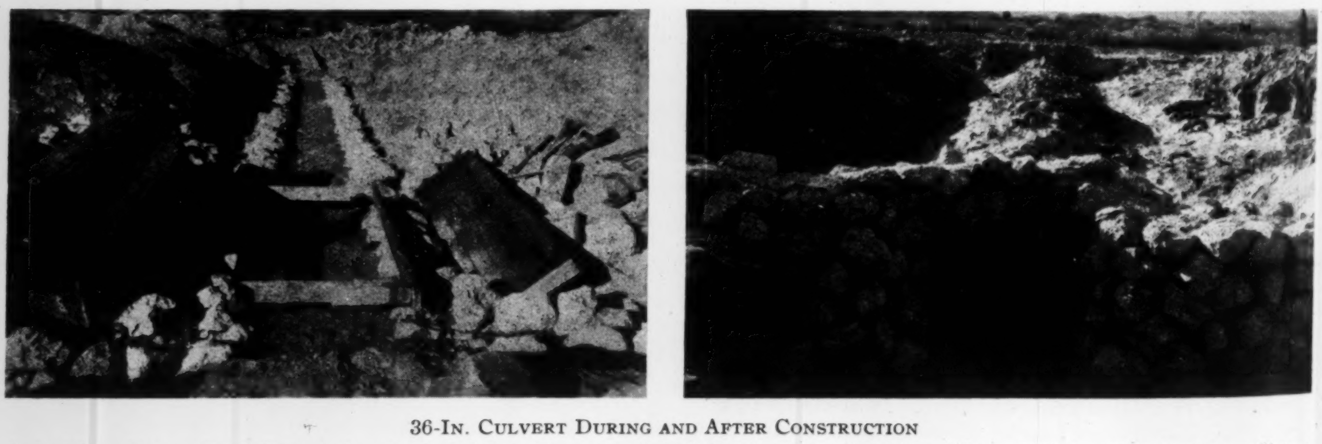
CONSULTANT TO GOVERNMENT OF IRAN, TEHRAN, IRAN

A METHOD of culvert construction has been perfected in the West that has general application in the vast road-building program now under way throughout the nation. Its use is limited to localities where rubble is readily available, and it is best adapted for use where funds for materials are limited and where skilled labor is scarce and unskilled labor available in quantity. The system was developed under these conditions and is now being used extensively by the "Triple C" and on work projects manned by relief labor. It has even been applied to advantage by contractors under a variety of conditions both for culvert construction for waterways and in the building of abutments for bridges, water control structures, dams, retaining walls, and linings for flood channels.

In such structures rubble may be used as a substitute for reinforced concrete or even for metal pipe culverts. The method of construction has been modified in two principal ways. First, instead of using mortar made of sand and cement between rocks, or between courses in accordance with common practice, the boulders are placed with their thicker ends face to face on the exterior side of the wall, each rock being securely wedged between two rocks already in place and resting firmly against the exposed surfaces of the saddle thus formed. The long axis of each rock points inward and downward, the inner portion being completely embedded in the concrete. In the second place, Grade A concrete is used in place of sand and cement mortar to fill all the interstices between boulders. The exterior of the wall is kept clean and has the appearance of dry riprap. The only concrete visible is that which has squeezed into the corners where the boulders do not fit perfectly together.

Wing walls and retaining walls of unusual strength and stability have been built by placing double rows of boulders successively in position, the rocks being largest in the base and decreasing in size as the wall rises. The limited amount of concrete used is spaded or tamped into the interior of the wall after the exterior course of boulders is in position. There is, however, an absence of coursing as is common in stone masonry. This makes for extreme economy in the use of cement and a very marked increase in strength. So far as the writer is aware, this type of wing or retaining wall has never been tested to the point of failure.

In lining flood channels it has been found sound practice to pave the floor of the channel by first placing a foundation layer of sand and over this a layer of concrete. Then, starting downstream, the boulders are placed on end, shingle-fashion, with the thick ends face to face in the upper surface, their long axes pointing downward, and the concrete completely filling the interstices between the rocks and completely surrounding the lower end of each boulder. This insures against the development of seeps under the floor as usually happens in common practice where the rocks are all placed first



36-IN. CULVERT DURING AND AFTER CONSTRUCTION

Left View Shows Sand Foundation Prepared for Concrete, in Which Boulders for Culvert Floor Will be Placed. Form Shown Is Only One Used and then grouted. The side walls are blended into the floor and the pavement is carried up each side to the desired height. These side walls are made only one rock thick, the concrete being spaded into place between the boulders and the natural bank against which they rest. No failures of revetments or channel linings built in this way have been observed in the 18 years since the first one of record was built.

In building a low retaining wall, wing wall, or bridge abutment, it is sometimes convenient to use a form on one side and build the other side of rocks placed as described. In this case concrete is spaded between the form and the successive layers of boulders. The space next to the form is not filled to the level of the top surface of the boulder except on the last course. This makes it possible to point the long axis of each rock in a downward position, sloping toward the form, and permits the worker to wedge each rock into place so that it finds a good bearing in the saddle between the boulders already in position. It also eliminates the tendency to use too much concrete, which reduces the strength and stability of the wall and increases the expense.

Rubble masonry of the type described has been used for road culverts in many places throughout the West, with very satisfactory results. Where CCC, WPA, or NYA labor is available, the cost to the sponsor of the project is reduced to as little as 10% of the normal cost for materials. The resulting structure is permanent.

In building a rubble culvert 4 to 8 ft in diameter, an inner form of the shape and size required is built in such a way that it can be removed readily and used over and over again without reassembling. Relatively dry concrete is spaded between the boulders and the inner form. This makes it possible to move the form forward as soon as a section is finished. The barrel form is built in sections 12 to 16 ft long for convenient handling.

In building the barrel of an arched culvert, the boulders are placed in such a manner that each rock becomes a keystone, with its thick end on the outside and its axis pointing directly toward the center of the arc. In this manner a 4 by 5-ft road culvert may be built with one bag of cement per lineal foot of culvert, including the usual wing walls at each end. The amount of concrete required varies inversely with the size of the boulders used. In other words, small rocks consume more concrete than large ones for the same thickness of wall.

Rubble Masonry Road Culvert, 4 by 4 by 40 Ft, Used Only 42 Bags of Cement

For greater economy and maximum strength, only the largest boulders that can be handled and placed readily should be used. A sloppy mix should never be used. The concrete should be spaded or tamped thoroughly and the resulting structure will prove its value in the field of modern construction.

Slide Rule for Designing Reinforced Concrete Beams

By W. N. Hazen, M. Am. Soc. C.E.

West Orange, N.J.

For use in simplifying the process of finding the required width and area of steel reinforcement for concrete beams of different depths, the writer has devised the slide rule illustrated below.

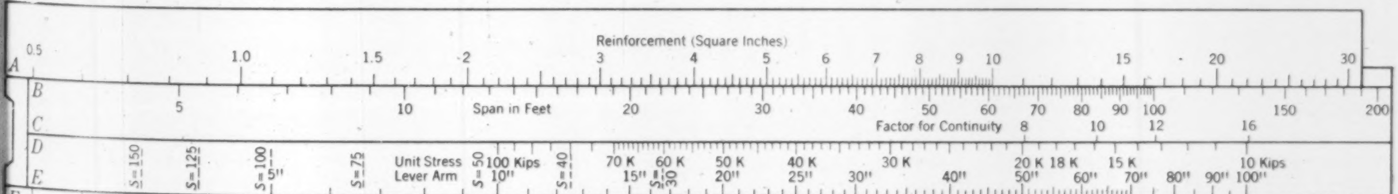
On scale D the graduations are carried to 100 kips to cover any condition, such as finding the breaking load on a beam. The "factor for continuity" is the denominator of the bending moment equations. There is very little friction between the slide carrying scale A and the slide carrying scale B. Therefore, slides carrying scales B, C, D, and E move as a unit.

The method of using this slide rule for designing is as follows: First, set the appropriate factor for continuity opposite the allowable unit stress in the steel. Second, place an assumed lever arm opposite the total load, then opposite the specified shear S on scale E, read the required width of the beam on scale F. Move the two center slides as a unit until a satisfactory shape of beam is found. Third, read the area of the reinforcement opposite the span length.

This slide rule is made for uniform loads. For designing a beam or girder having concentrated loads, use a uniform load giving the same moment or shear at the point in question.

In light building work, the lever arm, plus one inch, is very nearly the same as depth of beam below bottom of slab, particularly if the beam is reinforced with one layer of rods.

Simple methods of testing slabs forming T-beams, for stresses due to beam action, are easy to work out.


Reinforcement (Square Inches)
A
0.5 1.0 1.5 2 3 4 5 6 7 8 9 10 15 20 30
B
5 10 Span in Feet 20 30 40 50 60 70 80 90 100 150 200
C
Factor for Continuity 8 10 12 16
D
E
S=150 S=125 S=100 S=75 S=50 S=40 S=30
Unit Stress 100 Kips 70 K 60 K 50 K 40 K 30 K 20 K 18 K 15 K 10 Kips
Lever Arm 5" 10" 15" 20" 25" 30" 40" 50" 60" 70" 80" 90" 100"
F
5 Kips 5"
Total Load 10 K 15 K 20 K 30 K 40 K 50 K 60 K 70 K 80 K 90 K 100 K 150 K 200 K 300 Kips
Width of Beam 10" 20" 30"

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

The Engineer in the World Crisis

Dear Sir: I have read with much interest the article by Bernard L. Weiner, in the December issue, entitled "Engineers and World Economy." But I am not so sure that the introduction of engineering thinking and engineering methods into the field of economics will prevent "the repeated breakdown of the world economy" which "has brought civilization to the brink of disaster." Financial depressions and wars which break down world economy are the product of the emotions, not of the intellect, and it is to the intellect that the engineer appeals. How can the engineer, accustomed to the fixed laws of mathematics, understand the mutable impulses that govern the emotions? That is more the province of the psychologist and the politician.

The emotional impulse of the people at large to pay for goods and services more than they are worth finally results in major depressions such as this country experienced in 1873, 1893, and 1929. Nor have these periods of emotional stress been confined to recent decades; they were well illustrated in the tulipomania of the early seventeenth century in Holland. There the over-speculation in tulips was followed by just as serious a depression as that caused by our recent over-speculation in stocks, and the business of Holland received a severe shock from which it took many years to recover.

The author is quite right when he says ". . . that from the engineering point of view there is no reason why production cannot continue at least at the same pace as now—except that consumers' commodities will be produced." But from the financial point of view this would seem impossible, for present production is paid for largely by governmental debt and taxes, and history has shown that it is just as serious for a government to over-borrow as it is for an individual.

When we went into the World War the federal debt was one billion dollars, and the war ran it up to 25 billions in 1919. By 1930, through measures of economy, this had been reduced to 16 billions. In 1939, when we began preparing for the present war, the debt had increased to 40 billions, due to policies that were adopted largely to overcome the effects of the depression of 1929 and to prevent similar depressions in the future. It is interesting to note that, up to 1939, these measures had cost, in federal debt, as much as the World War.

Since 1930, increased governmental indebtedness and taxes have lowered the standard of living of the wealthy, as witness the razing of fine mansions by their owners in order to reduce real estate taxes. Next, in order to meet the cost of war through increased indebtedness and taxes the standard of living of the middle class will be lowered, and finally that of the workers. Therefore, it will probably be impossible, after the war, to continue the same pace of production, for the limit of indebtedness and taxes may then have been reached. I do not see how unemployment can then be avoided, and our people will have to accommodate themselves to a lower standard of living. However, assuming that the relations between government and business will be as cooperative as in the nineteenth century, a higher standard of living will be evolved more quickly than was the case between the close of the Civil War and the depression of 1929. This rapid recovery will be the result of advances in technology brought about by the engineer.

Philip W. Henry, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.

Surveys by Pacing

Dear Sir: Now that the U.S. Army pace is 30 in., four of which make 10 ft, the British Royal Engineers' method of pacing should be of use rather than the attempt to step yards. The method is as follows: Count mentally 0001, 0002, 0003, . . . 0010 = 100 ft. Similarly, 0011, 0012, . . . 0099, 0100 = 1,000 ft. Each digit, even the zeros, is counted, one to a step.

With slight practice this can be quite accurate enough for many purposes and, with a prismatic compass, good surveys can be made of camp sites, farms, and so forth.

R. A. MacGregor, M. Am. Soc. C.E.

New York, N.Y.

Computation of Flood Flows

To the Editor: The discussion in the September and October issues of Civil Engineering of my original article, which appeared in the July number, contains no specific denial of the fundamental principles involved, namely:

1. There can be but one value of discharge that satisfies the data, and a practical problem of this character reduces to the question: What discharge produced the observed hydraulic gradient?
2. The data for solution are present in the stream channel.
3. A sound engineering approach which will give a trustworthy answer requires collection of factual data and faithful adherence to these data throughout the necessary computations.

Flood flow and backwater problems represent varied flow conditions with variable stream cross section and velocity from point to point, and are distinct from uniform flow conditions in artificial channels of regular section from which come most experience factors of record. The application to varied flow problems of an assumed value of n derived from inapplicable experience records seems questionable.

The discussion has failed to justify faith in any assumed values of pertinent factors. Mr. Harrold's discussion includes Section D added by him, which does not apply to the practical problem for it is located more than 400 ft below the horseshoe falls in the stream and has an assumed water surface elevation which is distinctly contrary to fact, as reference to the field data will show (U.S. Geological Survey Water-Supply Paper 773-E referred to in my original article).

The interpretation and representation of the field data, questioned by Mr. Davenport, are the responsibility of others and were accepted by me to focus attention on the main issue. The field data should represent adequately the circumstances of a problem, and the necessary cross sections should be taken in amount and distributed in position to show breaks in grade and contour properly, so that joining two adjacent points by a straight line is a reasonable procedure.

Mr. Eisenlohr's equation for S seems unnecessary. Emphasis should be placed on solving for n, which is much the larger of the two decimal factors, and thereby avoid mathematical difficulties.

A check of the computations is obtained by working the problem backward, computing the hydraulic gradient produced by the computed discharge and comparing that result with the observed hydraulic gradient. In the current case, the hydraulic gradient for a computed discharge of 17,800 cu ft per sec checked the observed gradient closely with a departure of less than 0.1 ft, which is well within the accuracy of the determination of the mean hydraulic gradient shown in the field data. The check computation completed the circle. The subsidiary factors entering into the computations were handled identically throughout, so the fundamental relationship between discharge and resulting hydraulic gradient is not impaired.

The average value (probable value of Q) arrived at by evaluating all the evidence presented in this discussion (U.S. Geological Survey Water Supply Paper 773-E; Davison; Harrold; Davenport; Eisenlohr, 5 values) gives a total of 138,300 or an average of 17,300.

Assumptions do not solve practical problems; they evade them. Public confidence in engineering and resulting appropriations for necessary public works are earned by engineers' adherence to sound engineering principles and a determination to stick to the factual data furnished by the natural forces that produce engineering problems. A deficiency of factual data is not the fault of natural forces.

A. H. Davison

Providence, R.I.

Eighty-Ninth Annual Meeting

New York, N.Y., January 21–24, 1942

Program of Sessions, Entertainment, and Trips

Business Meeting, Prize Awards, Conferring of Honorary Membership

WEDNESDAY—January 21, 1942—Morning

Auditorium

9:00 **Registration**

10:00 **Eighty-Ninth Annual Meeting called to order by** Frederick H. Fowler, *President, American Society of Civil Engineers.*

Report of the Board of Direction

Report of the Secretary

Report of the Treasurer

10:30 **Presentation of Society Medals and Prizes**

The Norman Medal to John A. Van den Broek, *M. Am. Soc. C.E., Professor, Engineering Mechanics, University of Michigan,* Ann Arbor, Mich., for Paper No. 2070, "Theory of Limit Design."

The J. James R. Croes Medal to Earl I. Brown, *M. Am. Soc. C.E., Colonel, Corps of Engineers, U.S.A. (Retired),* Wilmington, N.C., for Paper No. 2076, "Beach Erosion Studies."

The Thomas Fitch Rowland Prize to Oliver J. Todd, *M. Am. Soc. C.E., Engineer, U.S. Bureau of Reclamation,* Albuquerque, N.Mex., and Sigurd Eliassen, *Assoc. M. Am. Soc. C.E., Engineer, Cities Reconstruction Commission,* Oslo, Norway, for Paper No. 2064, "The Yellow River Problem."

The James Laurie Prize to Samuel A. Greeley, *M. Am. Soc. C.E., Greeley & Hansen,* Chicago, Ill., for Paper No. 2092, "Sewage Disposal Project of Buffalo, New York."

The Arthur M. Wellington Prize to Fred Lavis, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y., for Paper No. 2061, "Transportation Developments in the United States."

The Collingwood Prize for Juniors to Elmer Rock, *Jun. Am. Soc. C.E., Associate Civil Engineer, Corps of Engineers, U.S. Engineer Office,* Richmond, Va., for Paper No. 2080, "Design of a High-Head Siphon Spillway."

The Rudolph Hering Medal to Thomas H. Wiggin, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y., for his "noteworthy, painstaking and thorough annual reviews of progress, developments and trends in water supply engineering and water works practices since 1933."

The Construction Engineering Prize to E. Leland Durkee, *M. Am. Soc. C.E., Resident Engineer, Bethlehem Steel Co.,* Bethlehem, Pa., for paper in March 1941 issue of Civil Engineering, "Erection Methods on Baton Rouge Bridge."

The Karl Emil Hilgard Hydraulic Prize to Thomas R. Camp, *M. Am. Soc. C.E., Associate Professor of Sanitary Engineering, Massachusetts Institute of Technology,* Cambridge, Mass., for Paper No. 2069, "Lateral Spillway Channels."

The Daniel W. Mead Prize to Don P. Reynolds, *Jun. Am. Soc. C.E., Engineer, Sun Oil Co.,* Toledo, Ohio, for the best paper by a Junior of the Society on "Ethics of Junior Construction Engineers," and to Edward Wesp, Jr., Mount Vernon, N.Y., for the best paper submitted by a Student on "Ethics of the Engineer Inspector."

11:00 **Conferring of Honorary Membership**

Ralph Budd, *M. Am. Soc. C.E., President, Chicago, Burlington and Quincy Railroad,* Chicago, Ill.

Mr. Budd will be presented to the President by Alonzo J. Hammond, *Past-President, Am. Soc. C.E., Consulting Engineer,* Evanston, Ill.

William Kelly, *M. Am. Soc. C.E., Colonel, Corps of Engineers, U.S.A., President, Buffalo, Niagara and Eastern Power Corporation,* Buffalo, N.Y.

Col. Kelly will be presented to the President by Edward P. Lupfer, *M. Am. Soc. C.E., President, Edward P. Lupfer Corporation,* Buffalo, N. Y.

Henry E. Riggs, *Past-President, Am. Soc. C.E., Honorary Professor, Civil Engineering, University of Michigan,* Ann Arbor, Mich.

Dr. Riggs will be presented to the President by Lewis M Gram, *M. Am. Soc. C.E., Professor, Civil Engineering, University of Michigan,* Ann Arbor, Mich.

John L. Savage, *M. Am. Soc. C.E., Chief Designing Engineer, U.S. Bureau of Reclamation,* Denver, Colo.

Mr. Savage, who will be represented by his sister, Mrs. M. S. Winston, will be presented to the President by Joseph Jacobs, *Vice-President, Am. Soc. C.E., Consulting Engineer,* Seattle, Wash.

Henry M. Waite, *M. Am. Soc. C.E., Colonel, Consultant for the Budget, U.S. Government,* Washington, D.C.

Col. Waite will be presented to the President by Arthur S. Tuttle, *Past-President, Am. Soc. C.E., Consulting Engineer, Arthur S. Tuttle and Elwyn E. Seelye,* New York, N.Y.

11:30 **New Business**

Report of Tellers on Canvass of Ballot for Officers

Introduction of President-Elect and New Officers

12:00 **Members' Luncheon**

Fifth Floor, Engineering Societies Building. Tickets $1.25 each.

12:15 **Student Luncheon**

Midston House, 22 East 38th Street, New York, N.Y. Tickets for members will be $1.25 each and for Students 60 cents each.

Bermuda Trip Abandoned

Because of the declaration of war against the Axis powers, the proposed trip to Bermuda to inspect Army and Navy base construction has been wholly abandoned.

Sessions of Technical Divisions

WEDNESDAY—January 21, 1942—Afternoon

PREPAREDNESS FOR POST-WAR CONDITIONS

Program Sponsored by the Society's Committee on Preparedness for Post-War Conditions

WEDNESDAY—January 21, 1942—Afternoon

Auditorium—Time, 2:00 p.m.

ENOCH R. NEEDLES, *Chairman, Society's Committee on Preparedness for Post-War Conditions, Presiding*

2:00 **Introductory remarks**

ENOCH R. NEEDLES, *M. Am. Soc. C.E., Consulting Engineer, Howard, Needles, Tammen & Bergendoff,* New York, N.Y.

2:10 **A Practical Approach to the Public Works Program**

FRANCIS W. HERRING, *M. Am. Soc. C.E., Assistant Director, National Resources Planning Board,* Washington, D.C.

2:40 **Discussion by**

HENRY M. WAITE, *Hon. M. Am. Soc. C.E., Colonel, Consultant for the Budget, U.S. Government,* Washington, D.C.

2:50 **The Public Work Reserve**

A. D. MORRELL, *National Director, Public Work Reserve,* Washington, D.C.

3:20 **Discussion by**

ARTHUR S. TUTTLE, *Past-President, Am. Soc. C.E., Consulting Engineer, Arthur S. Tuttle and Elwyn E. Seelye,* New York, N.Y.

3:30 **Highway Construction in the Post-War Period**

G. DONALD KENNEDY, *M. Am. Soc. C.E., State Highway Commissioner,* Lansing, Mich.

4:00 **Discussion by**

WALDO G. BOWMAN, *Assoc. M. Am. Soc. C.E., Editor, "Engineering News-Record,"* New York, N.Y.

4:10 **Municipal Public Works Construction**

ARTHUR C. EVERHAM, *M. Am. Soc. C.E., Director of Public Works,* Kansas City, Mo.

4:40 **Discusson by**

W. W. DEBERARD, *M. Am. Soc. C.E., City Engineer,* Chicago, Ill.

4:50 **General discussion**

WARDS IS.
Bolts
HALLETS PT
QUEENS
MANHATTAN
EAST RIVER MODEL HELL GATE VICINITY
VERIFICATION
1 HOURS AFTER MOON TRANSIT
EBB TIDE

MODEL SHOWING CURRENTS AT HELL GATE, EAST RIVER

CONSTRUCTION DIVISION

Room No. 502

HARRY O. LOCHER, *M. Am. Soc. C.E., Chairman, Executive Committee, Construction Division, and Secretary-Treasurer, The National Association of River and Harbor Contractors,* New York, N.Y., *Presiding*

2:30 **Cantonment Construction, Pine Camp, New York**

DANIEL B. NIEDERLANDER, *Vice-President and Manager, John W. Cowper Company, Inc.,* Buffalo, N.Y.

Discussion by

3:00 EDWARD P. PALMER, *M. Am. Soc. C.E., Secretary and Treasurer, Senior and Palmer, Inc.,* New York, N.Y.

3:10 DAVID G. ARONBERG, *Vice-President, Cauldwell-Wingate Company,* New York, N.Y.

3:20 **Delaware River Aqueduct Tunnel Construction Under Shawangunk Range for the Board of Water Supply of New York City**

FRED W. STIEFEL, *Assoc. M. Am. Soc. C.E., Chief Engineer, Samuel R. Rosoff, Ltd.,* Kerhonkson, N.Y.

Discussion by

4:00 PHILIP S. MILLER, *Assoc. M. Am. Soc. C.E., Resident Engineer, Samuel R. Rosoff, Ltd.,* Kerhonkson, N.Y.

4:10 PAUL BIRD, *Geologist, Board of Water Supply,* New York.

4:20 **General discussion**

WATERWAYS DIVISION

American Radiator Company Salon
6th Floor, 39 West 39th St., New York, N.Y.

R. E. BAKENHUS, *Member, Executive Committee, Presiding*

2:30 **Introductory remarks**

R. E. BAKENHUS, *M. Am. Soc. C.E., Rear-Admiral, C.E.C., U.S.N. (Retired), Consulting Engineer,* New York, N.Y.

2:40 **Model Study of Tidal Currents in East River, New York**

L. S. DILLON, *M. Am. Soc. C.E., Lieutenant-Colonel, Corps of Engineers, U.S.A., District Engineer, New York District,* New York, N.Y.

Discussion by

3:20 KENNETH E. FIELDS, *Jun. Am. Soc. C.E., Captain, Corps of Engineers, U.S.A., Director, U.S. Waterways Experiment Station,* Vicksburg, Miss.

3:30 R. E. BAKENHUS, *M. Am. Soc. C.E., Rear-Admiral, C.E.C., U.S.N. (Retired), Consulting Engineer,* New York, N.Y.

3:40 **General discussion**

3:50 **Coastal Erosion Problems and Planning**

THORNDIKE SAVILLE, *M. Am. Soc. C.E., Dean, College of Engineering, New York University,* New York, N.Y.

Discussion by

4:30 BALDWIN WOODS, *Chairman, National Water Resources Committee,* Washington, D.C.

4:40 ARTHUR S. TUTTLE, *Past-President, Am. Soc. C.E., Consulting Engineer, Arthur S. Tuttle and Elwyn E. Seelye,* New York, N.Y.

4:50 JOHN J. KINGMAN, *Brigadier-General, U.S.A., Senior Member, Beach Erosion Board,* Washington, D.C.

5:00 **General discussion**

SANITARY ENGINEERING DIVISION

Room No. 501C

Arthur D. Weston, *M. Am. Soc. C.E., Chairman, Executive Committee, Sanitary Engineering Division,* and *Director and Chief Engineer, Massachusetts Department of Public Health,* Boston, Mass., *Presiding*

All members are invited to examine carefully copies of reports distributed at meeting and to make recommendations in writing to chairmen of committees.

2:00 **Progress Report of Committee on Sewerage and Sewage Treatment**

Langdon Pearse, *M. Am. Soc. C.E., Sanitary Engineer, The Sanitary District of Chicago,* Chicago, Ill., *Chairman.*

2:20 **Discussion**

2:35 **Progress Report of Committee on Activated Sludge Practice**

Robert T. Regester, *M. Am. Soc. C.E., Consulting Engineer, Baltimore Life Building,* Baltimore, Md., *Chairman.*

2:55 **Discussion**

3:10 **Final Report of Committee on Advancement of Sanitary Engineering**

Charles Gilman Hyde, *M. Am. Soc. C.E., Professor, Sanitary Engineering, University of California,* Berkeley, Calif., *Chairman.*

3:25 **Discussion**

3:35 **Final Report of Committee on Salvage of Sewage**

A. M. Rawn, *M. Am. Soc. C.E., Chief Engineer and General Manager, Los Angeles County Sanitation Districts,* Los Angeles, Calif., *Chairman.*

3:50 **Discussion**

Section of East Side Highway, New York, During Construction
Queensboro Bridge and Welfare Island in Background

4:00 **Progress Report of Committee on Sewer Rental Laws**

Earl Devendorf, *Assoc. M. Am. Soc. C.E., Assistant Director, Division of Sanitation, State Department of Health,* Albany, N.Y., *Chairman.*

4:15 **Discussion**

4:25 **Final Report of Committee on Technical Aspects of Refuse Disposal**

Harrison P. Eddy, Jr., *M. Am. Soc. C.E., Consulting Engineer, Metcalf & Eddy,* Boston, Mass., *Chairman.*

4:40 **Discussion**

4:50 **Progress Report of Committee on Sewage Treatment Costs**

Wm. E. Stanley, *M. Am. Soc. C.E.,* Arlington, Va.

5:05 **Discussion**

5:15 **Memorandum Report of Committee to Revise "Definitions of Terms Used in Sewerage and Sewage Disposal Practice"**

W. W. Horner, *M. Am. Soc. C.E., Consulting Engineer, Horner & Shifrin,* St. Louis, Mo., *Chairman.*

Student Chapter Conference

WEDNESDAY—January 21, 1942

Engineering Societies Building

Program sponsored by the Society's Committee on Student Chapters, John H. Porter, Chairman; Metropolitan Section Committee on Student Chapters, R. E. Bakenhus, Chairman; Conference of Metropolitan Student Chapters, William M. Faller, 3d, Chairman

9:00 **Registration at Society Headquarters, Engineering Societies Building**

10:00 **General Session—Auditorium**

Students will join members of the Society.

Award of prizes, including presentation of the Daniel W. Mead Prize to Edward Wesp, Jr., Member of New York University Student Chapter.

12:15 **Student Luncheon, Midston House, 22 East 38th Street, New York, N.Y.**

Toastmaster: E. M. Hastings, *M. Am. Soc. C.E., Chief Engineer, Richmond, Fredericksburg and Potomac Railroad,* Richmond, Va., *Member, Society's Committee on Student Chapters.*

Welcome to New York

R. E. Bakenhus, *M. Am. Soc. C.E. Rear-Admiral, C.E.C., U.S.N.* (*Retired*), *Consulting Engineer,* New York, N.Y.

One-minute responses from each Chapter represented

Special tickets for members of Student Chapters—60 cents each.

Tickets to members of the Society—$1.25 each.

2:30 **Student Chapter Conference—Room 501 A and B**

2:35 **Welcome from Metropolitan Conference**

William M. Faller, 3d, Union City, N.J., *Chairman, Conference of Metropolitan Student Chapters, Presiding.*

2:40 **Student Chapter Activities**

John H. Porter, *M. Am. Soc. C.E., Consulting Engineer, J. H. Porter and Company,* St. Louis, Mo., *Chairman, Society's Committee on Student Chapters.*

2:50 **The Future for Young Engineers in War Time**

Frederick H. Fowler, *Retiring President of the Society, and Consulting Civil Engineer,* San Francisco, Calif.

3:10 **My Engineering Ancestors**

Starr Truscott, *M. Am. Soc. C.E., Chief, Hydrodynamics Division, Langley Memorial Aeronautical Laboratory,* Langley Field, Va.

3:40 **Discussion**

3:50 **Introduction of Chapters and members attending**

4:00 **Post War Planning**

Francis W. Herring, *M. Am. Soc. C.E., Assistant Director, National Resources Planning Board,* Washington, D.C.

4:30 **Discussion**

5:00 **Adjournment**

Students will join the members at Technical Division Sessions of their choice all day Thursday, at the Smoker and Entertainment at Manhattan Center Thursday evening, and on Inspection Trips on Friday and Saturday.

Student tickets for Smoker—$1.00 each.

Sessions of Technical Divisions

THURSDAY—January 22, 1942—Morning

STRUCTURAL DIVISION

Auditorium

EFFECTS OF BOMBING ON STRUCTURES

Joint meeting with the Society's National Committee on Civilian Protection in War Time

Shortridge Hardesty, *M. Am. Soc. C.E., Chairman, Executive Committee, Structural Division, and Consulting Engineer, Waddell & Hardesty,* New York, N.Y., *Presiding*

9:30 **Introductory remarks**

Ernest P. Goodrich, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y., *Vice-Chairman, Society's National Committee on Civilian Protection in War Time.*

9:45 **Scope of the Problem and Observations Made in England**

Walter D. Binger, *M. Am. Soc. C.E., Commissioner of Borough Works, Borough of Manhattan,* New York, N.Y., *Chairman, Society's National Committee on Civilian Protection in War Time.*

10:15 **Damage to Buildings and Recommended Design Practice**

Harold E. Wessman, *M. Am. Soc. C.E., Chairman, Department of Civil Engineering and Professor, Structural Engineering, College of Engineering, New York University,* New York, N.Y.

10:45 **Damage to Burster, Slabs, Shelters, and Other Structures**

John I. Parcel, *M. Am. Soc. C.E., Consulting Engineer Sverdrup & Parcel,* St. Louis, Mo., *Structures Division, Society's National Committee on Civilian Protection in War Time.*

11:15 **General discussion**

SURVEYING AND MAPPING DIVISION

Room No. 1101

William N. Brown, *M. Am. Soc. C.E., Chairman, Executive Committee, Surveying and Mapping Division, and President, W. N. Brown, Inc.,* Washington, D.C., *Presiding*

9:00 **Open Meeting of Executive Committee**

Reports of Committee Chairmen and round-table discussion of surveying and mapping subjects.

All interested members welcomed.

HYDRAULICS DIVISION, COMMITTEE ON HYDROLOGY

Room No. 501 B and C

SYMPOSIUM ON HYDROLOGY OF ELEMENTS CONTRIBUTING TO FLOODS

First of a series of symposiums on floods under the auspices of the Hydraulics Division

Thorndike Saville, *M. Am. Soc. C.E., Chairman, Committee on Hydrology, Hydraulics Division, and Dean, College of Engineering, New York University,* New York, N.Y., *Presiding*

9:30 **Primary Role of Meteorology in Flood Flow Estimating**

Merrill Bernard, *M. Am. Soc. C.E., Principal Hydrologist, U.S. Weather Bureau,* Washington, D.C.

10:00 **Discussion**

10:10 **Role of the Land During Flood Periods—Relations Between Rainfall and Stream Channel Inflow**

W. W. Horner, *M. Am. Soc. C.E., Consulting Engineer, Horner & Shifrin,* St. Louis, Mo.

Discussion by

10:40 L. K. Sherman, *M. Am. Soc. C E., Consulting Engineer,* Chicago, Ill.

10:45 W. G. Hoyt, *M. Am. Soc. C.E., Principal Hydraulic Engineer, Water Resources Branch, U.S. Geological Survey,* Washington, D.C.

10:50 **Derivation of Critical Flood Hydrographs**

Gail A. Hathaway, *M. Am. Soc. C.E., Hydraulic Engineer, War Department, Office, Chief of Engineers,* Washington, D.C.

Discussion by

11:20 William P. Creager, *M. Am. Soc. C.E., Consulting Engineer,* Buffalo, N.Y.

11:25 Gordon R. Williams, *Assoc. M. Am. Soc. C.E., Associate Hydraulic Engineer, U.S. Engineer Office,* Baltimore

11:30 **General discussion opened by**

Robert E. Horton, *M. Am. Soc. C.E., Consulting Hydraulic Engineer,* Voorheesville, N.Y.

SOIL MECHANICS AND FOUNDATIONS DIVISION

Room No. 502

Carlton S. Proctor, *Chairman, Executive Committee, Presiding*

9:30 **Introductory remarks**

Carlton S. Proctor, *M. Am. Soc. C.E., Consulting Engineer, Moran, Proctor, Freeman & Mueser,* New York

9:35 **Résumé of the Program and Acitivites of the Committee on Sampling and Testing**

Joel D. Justin, *M. Am. Soc. C.E., Consulting Engineer,* Philadelphia, Pa.

9:45 **General Directions for Undisturbed Sampling of Soils by Drive Sampling Methods**

M. Juul Hvorslev, *Assoc. M. Am. Soc. C.E., Research Engineer,* Cambridge, Mass.

10:30 **Practical Difficulties and Limitations in Undisturbed Sampling**

Thomas E. Stanton, *M. Am. Soc. C.E., Materials and Research Engineer, State Division of Highways,* Sacramento, Calif.

11:00 **Relation of Undisturbed Sampling to Laboratory Testing**

P. C. Rutledge, *Assoc. M. Am. Soc. C.E., Professor, Purdue University,* West Lafayette, Ind.

Discussion by

11:20 Frank E. Fahlquist, *Assoc. M. Am. Soc. C.E., Senior Geologist, U.S. Engineer Office,* Providence, R.I.

11:30 Benjamin K. Hough, Jr., *Assoc. M. Am. Soc. C.E., Senior Engineer, U.S. Engineer Dept.,* Ithaca, N.Y.

11:40 Kenneth E. Fields, *Jun. Am. Soc. C.E., Captain, Corps of Engineers, U.S.A.; Director, U.S. Waterways Experiment Station,* Vicksburg, Miss.

11:50 **General discussion**

Double-Deck Section of East Side Highway, New York
Showing Utilization of Area Above Highway

Occupy Entire Day Thursday

CITY PLANNING DIVISION

Room No. 501A

Symposium on the Effect of Defense Project Locations on Official City Plans

Harland Bartholomew, *M. Am. Soc. C.E., Chairman, Executive Committee, City Planning Division, Harland Bartholomew & Associates*, St. Louis, Mo., *Presiding*

10:00 **Washington, D.C.**

John Nolen, Jr., *Assoc. M. Am. Soc. C.E., Director of Planning, National Capital Park and Planning Commission*, Washington, D.C.

10:30 **Louisville, Ky.**

Carl Berg, *Engineer, City Planning and Zoning Commission*, Louisville, Ky.

11:00 **Wichita, Kans.**

P. L. Brockway, *M. Am. Soc. C.E., City Engineer*, Wichita, Kansas.

11:30 **Discussion opened by**

Harold M. Lewis, *M. Am. Soc. C.E., Chief Engineer, Regional Plan Association, Inc.*, New York, N.Y.

SANITARY ENGINEERING DIVISION

Room No. 503

Arthur D. Weston, *M. Am. Soc. C.E., Chairman, Executive Committee, Sanitary Engineering Division, and Director and Chief Engineer, Massachusetts Department of Public Health*, Boston, Mass., *Presiding*

10:00 **The Mechanism of Filtration of Water by Rapid Sand Filters**

P. C. Stein, *Assoc. M. Am. Soc. C.E., Instructor, Massachusetts Institute of Technology*, Cambridge, Mass.

10:40 **Discussion**

10:50 **Design of Sanitation Facilities for Military Posts**

Samuel A. Greeley, *M. Am. Soc. C.E., Greeley and Hansen*, Chicago, Ill., and E. Sherman Chase, *M. Am. Soc. C.E., Consulting Engineer, Metcalf and Eddy*, Boston, Mass.

11:30 **Discussion**

11:40 **Recent Illinois Waterway Litigation**

Langdon Pearse, *M. Am. Soc. C.E., Sanitary Engineer, The Sanitary District of Chicago*, Chicago, Ill.

12:20 **Discussion**

THURSDAY—January 22, 1942—Afternoon

ENGINEERING ECONOMICS DIVISION

Room No. 501B and C

COST ALLOCATION FOR MULTIPLE-PURPOSE WATER PROJECTS

Samuel B. Morris, *M. Am. Soc. C.E., Chairman, Committee on Cost Allocation for Multiple-Purpose Water Projects, Engineering Economics Division, and Dean, School of Engineering, Stanford University*, Stanford University, Calif., *Presiding*

2:00 **Willamette Valley Project Cost Allocations**

C. I. Grimm, *M. Am. Soc. C.E., Head Engineer, North Pacific Division*, Portland, Ore., and F. Kochis, *Assoc. M. Am. Soc. C.E., Senior Engineer, Portland District, Army Engineers, War Department*, Portland, Ore.

Discussion by

2:30 B. E. Torpen, *M. Am. Soc. C.E., Principal Engineer, U.S. Engineer Office, War Department*, Portland, Ore.

2:40 R. E. MacKenzie, *M. Am. Soc. C.E., Senior Engineer, Office of Division Engineer, War Department*, Portland, Ore.

2:50 **Boulder Canyon Project, Original and Readjusted Repayment Contracts**

C. C. Elder, *M. Am. Soc. C.E., Hydrographic Engineer, Metropolitan Water District of Southern California*, Los Angeles, Calif.

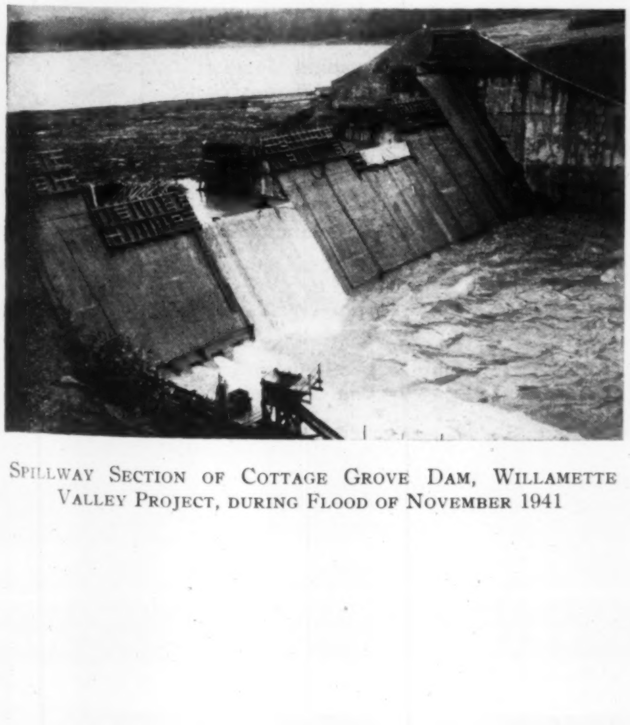
Discussion by

3:30 A. R. Arledge, *M. Am. Soc. C.E., Principal Civil Engineer, Bureau of Power and Light, Department of Water and Power*, Los Angeles, Calif.

3:40 Wallace L. Chadwick, *M. Am. Soc. C.E., Chief Civil Engineer, Southern California Edison Company*, Los Angeles, Calif.

3:50 Munson J. Dowd, *M. Am. Soc. C.E., Chief Engineer and General Superintendent, Imperial Irrigation District*, Imperial, Calif.

4:00 **General discussion**



Spillway Section of Cottage Grove Dam, Willamette Valley Project, during Flood of November 1941

SOIL MECHANICS AND FOUNDATIONS DIVISION

Room No. 502

Carlton S. Proctor, *Chairman, Executive Committee, Presiding*

2:00 **Introductory remarks by Chairman**

2:05 **Possible Improvement in the Testing of Soils**

E. R. Fadum, *Jun. Am. Soc. C.E., Instructor in Civil Engineering, Harvard University*, Cambridge, Mass.

2:50 **Progress in the Methods of Soil Testing**

T. A. Middlebrooks, *Assoc. M. Am. Soc. C.E., Senior Engineer, Engineer Department*, Washington, D.C.

3:15 **Possibilities of Standardization in the Testing of Soils**

G. P. Tschebotarioff, *M. Am. Soc. C.E., Assistant Professor, Civil Engineering, Princeton University*, Princeton, N.J.

Discussion by

3:40 John D. Watson, *Assoc. M. Am. Soc. C.E., Assistant Professor, Civil Engineering, College of Engineering, Duke University*, Durham, N.C.

3:50 Donald W. Taylor, *Assoc. M. Am. Soc. C.E., Assistant Professor, Soil Mechanics, Massachusetts Institute of Technology*, Cambridge, Mass.

4:00 Hamilton Gray, *Jun. Am. Soc. C.E., Assistant Professor, Civil Engineering, New York University*, New York, N.Y.

Sessions of Technical Divisions
(Continued)

THURSDAY—January 22, 1942—Afternoon

HIGHWAY DIVISION

Room No. 501A

R. W. Crum, *M. Am. Soc. C.E., Chairman, Executive Committee, Highway Division, and Director, Highway Research Board, National Research Council*, Washington, D.C., *Presiding*

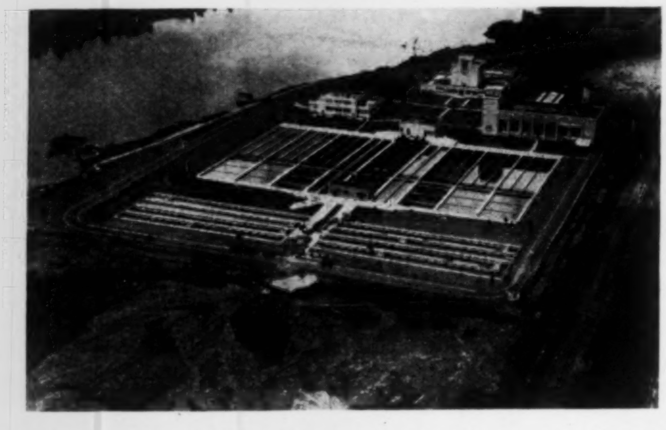
2:30 **Parkways in the New York Metropolitan Area**

Sidney M. Shapiro, *Assoc. M. Am. Soc. C.E., Deputy Chief Engineer, Long Island State Park Commission*, Babylon, N.Y.

3:05 **One Year's Operation of the Pennsylvania Turnpike**

T. J. Evans, *Vice-Chairman, Pennsylvania Turnpike Commission*, Harrisburg, Pa.

3:45 **General discussion**



Minneapolis–St. Paul 134-Mgd Sewage Treatment Plant Provides for Dewatering of Sludge and Incineration

SANITARY ENGINEERING DIVISION

Room No. 503

SYMPOSIUM ON DEWATERING, DRYING AND INCINERATION OF SLUDGE

W. Rudolfs, *M. Am. Soc. C.E., Chief, Department of Water and Sewage Research, New Jersey Agricultural Experiment Station*, New Brunswick, N.J., *Presiding*

2:30 **Dewatering and Drying of Sludge**

C. E. Keefer, *M. Am. Soc. C.E., Associate Engineer, Bureau of Sewers, Department of Public Works*, Baltimore, Md.

2:45 **Dewatering of Sludge by Vacuum Filters in Combination with Heat-Drying, Incineration and Preparation for Fertilizer**

W. A. Dundas, *Engineer of Mechanical Design, The Sanitary District of Chicago*, Chicago, Ill.

C. P. McLaughlin, *Assistant Engineer of Mechanical Design, The Sanitary District of Chicago*, Chicago, Ill.

3:05 **Drying and Incineration**

George J. Schroepfer, *Assoc. M. Am. Soc. C.E., Chief Engineer and Superintendent, Minneapolis–Saint Paul Sanitary District*, St. Paul, Minn.

C. R. Velzy, *M. Am. Soc. C.E., Works Superintendent, Buffalo Sewer Authority*, Buffalo, N.Y.

3:30 **Dewatering**

Ralph E. Fuhrman, *Assoc. M. Am. Soc. C.E., Assistant Superintendent, Sewage Treatment Plant, Department of Sanitary Engineering, Government of the District of Columbia*, Washington, D.C.

Albert L. Genter, *M. Am. Soc. C.E., Consulting Engineer, Wyman Park Apartments*, Baltimore, Md.

3:50 **Fertilizer**

LeRoy W. Van Kleeck, *Assoc. M. Am. Soc. C.E., Senior Sanitary Engineer, State Department of Health*, Hartford, Conn.

4:00 **General discussion**

4:20 **Delaware Water Supply of the City of New York (illustrated)**

Roger W. Armstrong, *M. Am. Soc. C.E., Deputy Chief Engineer, Board of Water Supply*, New York, N.Y.

4:50 **Discussion**

Tunnel on the Pennsylvania Turnpike Through Allegheny Mountain

STRUCTURAL DIVISION

Auditorium

Program Sponsored by the Structural Division's Committees on Design in Lightweight Structural Alloys; on Structural Alloys; and on Applied Mechanics

Shortridge Hardesty, *M. Am. Soc. C.E., Chairman, Executive Committee, Structural Division and Consulting Engineer, Waddell & Hardesty*, New York, N.Y., *Presiding*

2:00 **Comparative Tests of Riveted and Pin-Connected Joints of Steel and Aluminum Alloys**

Joint paper by L. S. Moisseiff, *M. Am. Soc. C.E., Consulting Engineer*, New York, N.Y., E. C. Hartmann, *Assoc. M. Am. Soc. C.E., Research Engineer, Aluminum Research Laboratories, Aluminum Company of America*, New Kensington, Pa., and R. L. Moore, *Assoc. M. Am. Soc. C.E., Research Structural Engineer, Aluminum Research Laboratories, Aluminum Company of America*, New Kensington, Pa.

To be presented by L. S. Moisseiff, *Chairman, Committee on Design in Lightweight Structural Alloys.*

2:30 **Discussion**

2:40 **Relation Between Physical Properties of Materials and the Behavior of Structural Members**

Wilbur M. Wilson, *M. Am. Soc. C.E., Research Professor, Structural Engineering, Civil Engineering Department, University of Illinois*, Urbana, Ill., *Chairman, Committee on Structural Alloys.*

3:10 **Discussion**

3:20 **Progress Report of Committee on Design of Structural Members**

B. G. Johnston, *Assoc. M. Am. Soc. C.E., Associate Director, Fritz Engineering Laboratory, Lehigh University*, Bethlehem, Pa., *Chairman.*

3:30 **Aerodynamics and Suspension Bridges**
Sponsored by the Committee on Applied Mechanics

Theodor von Kármán, *M. Am. Soc. C.E., Director, Daniel Guggenheim Aeronautical Laboratories, California Institute of Technology*, Pasadena, Calif.

4:20 **Discussion**

Dinner, Reception, and Dance

WEDNESDAY—January 21, 1942—Evening

Hotel Waldorf-Astoria

Committee: Ellis E. Paul, *Chairman,* J. W. Barker *and* E. K. Timby

7:00 **Assembly**

7:45 **Dinner**

9:30 **Reception to the President and Honorary Members**

10:00 **Dancing**

This function will be held in the Grand Ballroom of the Hotel Waldorf-Astoria, Park Avenue and 50th Street.

Dinner will be served promptly at 7:45 p.m.

Arrangements have been made for tables seating ten persons, and members may underwrite complete tables. Orders to underwrite a table must be accompanied by check in full and a list of guests.

Tickets will be $6.00 each. Tickets for Juniors, for the dance only, will be $2.00 per couple.

The seating list for the dinner-dance will close at 5:00 p.m., Tuesday, January 20, 1942. Those who purchase tickets after that hour will be assigned to tables in the order of purchase. Tickets will be on sale at Society Headquarters until 5:00 p.m., Wednesday, January 21, 1942.

Ladies Luncheon and Entertainment

THURSDAY—January 22, 1942—Afternoon

Grand Ballroom, Hotel Biltmore
(43d Street and Madison Avenue)

Commitee: Homer R. Seely, *Chairman,* David G. Baillie, Jr.

12:30 Ladies Luncheon and Entertainment

The ladies this year may anticipate an unusual entertainment. The Committee has arranged for an emotional treat following luncheon in the Grand Ballroom of the Hotel Biltmore. It is a demonstration and explanation of colors and their effects on human reactions; colors in attire, in home furnishings, in commercial production, and in the field of science. We see "red" when angry, feel "blue" on Monday morning, speak of being in the "pink" of condition, are stimulated by bright colors, depressed by somber hues.

"Exploring the Magic World of Color" is a trip the ladies may enjoy without moving from the ballroom.

Herbert Thompson Strong, of the New York Museum of Science and Industry, assisted by Miss Greta Frey, will introduce his audience to the mysteries of polarized light, ultra violet dyes, prismatic rays, quartz crystals, and the manner in which colors influence our daily lives.

Tickets for the luncheon and the afternoon entertainment are $1.00 each.

Chrysler Building Seen Through an Arch of Queensboro Bridge

Triborough Bridge, Hell Gate Bridge, and Ward's Island Sewage Disposal Plant from the Air

Smoker

THURSDAY—January 22, 1942—Evening

Committee: F. R. W. Cleverdon, *Chairman,* R. R. Graham

Place **Manhattan Center, 311 West 34th Street**
(34th Street near Eighth Avenue)

Time 8:00 p.m. **Doors open at 7:30 p.m.**

The Smoker this year is to be held on Thursday night again. Manhattan Center has been chosen with its newly arranged and decorated ballroom on the street floor. Not only is its location convenient but also the place is spacious enough to accommodate with ease the large number of members, students, and guests expected.

Beginning at 8:00 o'clock, there will be a number of entertainment features lasting about an hour. Following the entertainment, members may stay as late as they wish to meet old friends and renew acquaintances. Of course there will be the customary smokes and refreshments.

Members' and Students' Tickets—$1.00 each.

Guest Tickets—$2.00 each.

Motion Pictures of Current Construction Projects and Boat Excursion Around New York Harbor Are Scheduled for Friday

FRIDAY—January 23, 1942

Motion Pictures of Current Construction Projects in the United States

9:30 to 11:00 a.m.—Auditorium

A one-and-one-half hour program of motion pictures of current construction projects in the United States, including defense projects, has been arranged by the Committee. Following the showing of the films, members, ladies, and guests will leave the Engineering Societies Building for the West 42d Street Ferry Slip. Members may reach the 42d Street Ferry Slip on the 42d Street surface cars, which may be boarded at Sixth Avenue, or by taxi from the Engineering Societies Building. Adjournment of the moving picture session will be promptly at 11:00 o'clock. The boat is scheduled to depart at 11:30 a.m. Box lunches will be served on board.

Boat Excursion Around New York Harbor

Excursion Committee: JOHN M. BUCKLEY, *Chairman*, E. L. MACDONALD, *Vice-Chairman*, S. M. SHAPIRO, JULIUS W. PFAU

11:30 a.m. to 4:00 p.m.

A boat excursion trip on the Hudson River, around New York Harbor and up the East River, will permit members to see the famous skyline of metropolitan New York, and waterfront construction work now under way or completed. Members, students, and guests, will board a large passenger ferry boat furnished through the courtesy of the New York Central Railroad Company at the West Shore Railroad Ferry Terminal on the Hudson River at the foot of West 42d Street. The boat is scheduled to leave the slip at 11:30 a.m. Street car or taxi to the slip.

Up the broad Hudson River, the boat will proceed to permit a river view of such points of interest as the transatlantic liner piers, the West Side Express Highway, Rockefeller Center, Grant's Tomb, Riverside Drive Church, and the George Washington Bridge.

Returning southward, the boat will pass the New Jersey Palisades, and Hoboken and Jersey City with their important railhead terminals; the new lease-lend pier under construction by the Corps of Engineers of the Army; Governors Island; the Statue of Liberty; and the new Bayonne Dry Dock being built by the Civil Engineer Corps of the U.S. Navy. Still further south in New York Harbor will be seen lower Bayonne with its large oil refineries, the Kill Van Kull and Staten Island waterfronts. At the Narrows will be noted the government fortifications at Fort Wadsworth on Staten Island and Fort Hamilton on the Brooklyn shore. Through the Narrows, transatlantic vessels will be seen entering and leaving the Port of New York.

Returning north along the Brooklyn part of the upper Bay, the boat will pass along the busy Brooklyn waterfronts to the East River, permitting a view of the skyscraper district of downtown Manhattan and Brooklyn; will pass under the East River Bridges; past the Brooklyn Navy Yard, the new East River Drive and park developments.

A special loud speaker system will be used to explain the points of interest to be observed as the trip proceeds.

This excursion will provide a river preview of some projects to be seen on the Saturday motor-coach caravan.

NO CAMERAS PLEASE. Leave them at home to avoid confiscation.

The trip will end at the West 42d Street starting point about 4:00 p.m.

Tickets for members, students and guests, including box luncheon—$1.00 each.

Make reservations early.

Motor Coach Caravan Over the West Side and East Side Elevated Express Highways

A Close-up View of the Margin of Manhattan

SATURDAY—January 24, 1942—9:00 a.m. to 1:00 p.m.

The motor trip on Saturday morning, January 24, will include a view of many projects both completed and in process of construction along the margin of Manhattan Island.

Motor coaches will leave the Engineering Societies Building at 9:00 a.m. sharp, proceed west over 39th Street to the West Side Express Highway. At Tenth Avenue and Eleventh Avenue will be noted the approaches to the second tube of the Lincoln Tunnel under the Hudson River and the future underpass tunnel for the Bus Terminal at Ninth Avenue and 40th Streets. Proceeding south along the West Side Highway, at Canal Street guests will note the bowstring arch bridge of 360-ft span, 70 ft above the street, which carries the highway over it.

NEW MUNICIPAL ASPHALT PLANT FOR NEW YORK CITY, TO BE SEEN ON SATURDAY TRIP

Next they will pass the entrance plaza of the Holland Tunnel and the Washington Market, arriving at the Battery, where construction work on the entrance shaft to the recently authorized Brooklyn-Battery Tunnel may be seen.

Coaches will then proceed northward up the East Side, past the new Municipal Fulton Fish Market and the Vladeck Housing Development at Corlears Hook, which covers nine city blocks, and then along the construction of the reclaimed East River Park, where fill is being built with debris from bombed London.

At 36th Street, the coaches will pass through the Queens Midtown Tunnel, latest of New York City's tunnels under the East River, to Queens and return. Continuing northward up the East Side Drive, they will pass the three-decked section, numerous adjacent small park and playground developments, the new Municipal Asphalt Plant at 90th Street, the Harlem Housing Development between 105th and 110th Streets, and will arrive at the Triborough Bridge. Coaches will cross this to Randall's Island and make a circuit of the 200-acre park and playground Development now completed. The famous Hell Gate Arch and the Wards Island Sewage Disposal Plant may be seen to the east.

Leaving by the Bronx approach of the Triborough Bridge, the party will proceed over the Major Deegan Boulevard to the 178th Street Tunnel entrance to the George Washington Bridge over the Hudson River, which will be crossed to New Jersey and return.

Turning south the coaches will follow Riverside Drive along the Hudson River to 72d Street. The Drive overlooks the Henry Hudson Parkway, its grade-crossing eliminations and access roads. Coaches will then continue down the West Side Express Highway to 42d Street and return to the Engineering Societies Building about 1:00 p.m.

Tickets for members, students, and guests—$1.00 each.

College Reunions Throughout the Week

THURSDAY—January 22, 1942

Luncheon of Chi Epsilon Honorary Civil Engineering Fraternity

Members of Chi Epsilon, their families and their friends, are again extended a cordial invitation to attend a very informal luncheon at the Midston House, 22 East 38th Street, New York, N.Y., on Thursday, January 22, 1942, at 1:15 p.m. The charge will be $1.00 per person. Notify R. I. Land, 150 Broadway, New York, N.Y. (Cortlandt 7-5977) or H. T. Larsen, 33 West 39th Street, Room 1610, New York, N.Y. (Pennsylvania 6-9220, Ext. 87).

Luncheon of M.I.T. Engineers

All M.I.T. alumni are invited to a luncheon at the Technology Club of New York, 24 East 39th Street, New York, N.Y., on Thursday, January 22, 1942, at 12:30 p.m. Please notify the Technology Club (Caledonia 5-7424) as to attendance.

Rutgers University Annual Dinner

Rutgers University civil engineering alumni will meet for their annual dinner at 6:00 p.m., on Thursday, January 22, 1942, at the Hotel Bristol, 129 West 48th Street, New York, N.Y. The charge will be $1.25 per cover. Send checks to C. H. Gronquist, Room 1104, 117 Liberty Street, New York, N.Y.

Syracuse University Alumni Dinner

Graduates and former students of the College of Applied Science, Syracuse University, will hold an informal dinner at Rutley's, 1440 Broadway, New York, N.Y., at 6:30 p.m., on Thursday, January 22, 1942. Reservations at $1.50 per plate may be secured by writing Reo C. Miles, 29 Grundy Place, Merrick, Long Island.

Dinner of Cornell Society of Engineers

A dinner of the Cornell Society of Engineers will be held on Thursday, January 22, 1942, at 6:30 p.m. at the Cornell Club, 107 East 48th Street, New York, N.Y. Speakers will be announced later. If you plan to attend, please notify Paul Reyneau at the Cornell Club (Plaza 5-7210). All Cornellians are cordially invited.

University of Illinois Engineers' Supper Reunion

For the fourteenth consecutive year, civil engineer graduates of the University of Illinois, and their friends, will meet for an informal supper reunion at 6:00 p.m., on Thursday evening, January 22, 1942. This year, we have selected a restaurant almost directly across the street from the Engineering Societies Building with plenty of room available—the Lawrence Coffee House, 28 West 39th Street, New York, N. Y. As usual, alumni, teachers, friends, and acquaintances, all are invited—no speeches or formality—and supper will be over in ample time to permit everyone to reach the Smoker. Notify H. T. Larsen, Engineering Societies Building, 33 West 39th Street, Room 1610, New York, N.Y. (Pennsylvania 6-9220, Ext. 87) or M. N. Quade (Vanderbilt 6-3790).

FRIDAY—January 23, 1942

Brown Engineering Association

The Brown Engineering Association will hold its 28th annual dinner meeting at Stouffer's Restaurant, 540 Fifth Ave. (between 44th and 45th Streets), on Friday, January 23, 1942. Reception at 6:00 p.m., dinner at 6:30 p.m. Dr. Henry M. Wriston, President of the University, will be the principal speaker. All Brown alumni and friends are invited. The charge will be $1.75 per cover. Make reservations through Robert M. Bent (Lexington 2-3434).

Dinner of Columbia Engineers

The twenty-first annual Civil Engineering dinner of the graduates of the School of Engineering of Columbia University will be held at the Faculty Club, 117th Street and Morningside Drive, at 6:30 p.m., Friday, January 23, 1942. Our guest of honor will be O. H. Ammann, Consulting Engineer, D.S. (Hon.) 1941. Following the dinner there will be an inspection of the research laboratories of the Department. The charge of $2.00 will be collected at the dinner.

Thayer Society of Engineers of Dartmouth College

The annual meeting and dinner of the Thayer Society of Engineers of Dartmouth College will be held at the Dartmouth College Club, 30 East 37th Street, New York, N.Y., on Friday, January 23, 1942, at 6:30 p.m.

SATURDAY—January 24, 1942

Clarkson College Alumni Association

The annual meeting and dinner of the Clarkson College Alumni Association will be held at the Building Trades Employers' Association Club, 26th Floor, 2 Park Avenue, New York, N.Y., on Saturday, January 24, 1942, at 6:30 p.m.

There will also be an informal lunch and an afternoon meeting on the same day and in the same place.

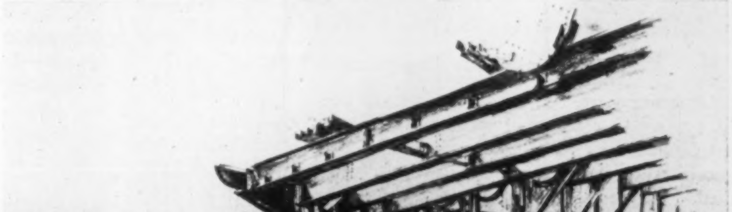
New York University Civil Engineering Alumni Dinner

This dinner will be postponed until April 1942.

Exhibition—Drawings of Engineering Construction

Members will be interested in an art exhibit which the Society is privileged to show on the fifteenth floor during the Annual Meeting. A large number of original pencil and watercolor drawings have been loaned especially for this event by the artist, Miss Lili Réthi. Trained in Vienna, she has done extensive work on the continent, in England, and in America.

Largely the exhibition will feature civil engineering construction work, most of it in America and around New York. There are some renditions of world-famed buildings, some of work in Denmark, and some in England, but all of it has been drawn from life and many views will depict activities still under construction. Those who have seen Miss Réthi's work reproduced in Civil Engineering will wish to examine more closely these originals on the fifteenth floor, for their atmosphere of reality, their perfection of detail. They will be on display only from Wednesday to Saturday of the Annual Meeting—15th Floor, Engineering Societies Building.



Elevated Highway Structure, from the Exhibition of Drawings of Engineering Construction—See Also Page of Special Interest

Meeting of the New York State Sewage Works Association

All Members of the Sanitary Engineering Division Are Invited

FRIDAY—January 23, 1942—Morning and Afternoon

8:30 Registration—Ballroom, Hotel McAlpin

10:00 Annual Meeting

11:15 Varied Problems in Design and Construction of Sewers at Lockport, New York

W. R. Drury, *M. Am. Soc. C.E., Consulting Engineer, Shoecraft, Drury and McNamee*, Ann Arbor, Mich.

12:15 Luncheon

2:15 Special Sewage Problems at Army Cantonments

Charles H. Capen, *M. Am. Soc. C.E., Principal Sanitary and Hydraulic Engineer, Constructing Quartermaster's Office, U.S.A., Zone II*, New York, N.Y.

3:00 The Effect of War on Material Used in Sewerage and Sewage Treatment

3:45 Accelerated Re-Aeration

R. G. Tyler, *M. Am. Soc. C.E., Professor, Sanitary Engineering, University of Washington*, Seattle, Wash.

4:30 Discussion

4:45 Description of Sewage Treatment Plants to be visited on Saturday inspection trip

5:15 Adjournment

FRIDAY—January 23, 1942—Evening

6:30 Annual Joint Dinner of Sanitary Engineering Division and New York State Sewage Works Association—Ballroom, Hotel McAlpin

Program—The speaking program will consist of an address by an eminent Sanitary Engineer on Civilian Defense Abroad and in the United States.

Price of tickets, approximately $2.50 each.

SATURDAY—January 24, 1942—All Day

9:00 Inspection Trip to Sewage Treatment Plants in Westchester County, New York

Buses will leave Hotel McAlpin at 9:00 a.m. sharp. Arrangements have been made to visit three of the lower Hudson River Sewage Treatment Plants, that is, those at Tarrytown, North Tarrytown, and Ossining.

Luncheon at Tarrytown.

Arrive back in New York at 4:00 p.m.

Tickets, including bus trip and luncheon, will be approximately $1.75 each.

Hotel Accommodations and General Announcements

Hotel Accommodations

In order to be certain of accommodations, members are urged to make definite arrangements for rooms at least a week in advance of the Annual Meeting.

	Hotel Rates Without Private Bath		With Private Bath	
Hotels	Single Room	Double Room	Single Room	Double Room
Waldorf-Astoria	......	......	$6.00 up	$9.00 up
Astor	......	......	3.50 up	5.00 up
Barclay	......	......	5.00 up	8.00 up
Biltmore	......	......	5.00 up	7.00 up
Chatham	......	......	5.00 up	7.00 up
Claridge	......	......	2.00 up	3.00 up
Commodore	......	......	3.00 up	5.00 up
Edison	......	......	2.50 up	4.00 up
Governor Clinton	......	......	3.00 up	4.00 up
Lexington	......	......	4.00 up	5.00 up
McAlpin	$2.00 up	$3.50 up	3.00 up	4.50 up
Murray Hill	2.00 up	3.00 up	2.50 up	4.00 up
New Yorker	......	......	3.50 up	5.00 up
Pennsylvania	......	......	3.50 up	5.00 up
Pierre	......	......	7.00 up	9.00 up
Plaza	......	......	6.00 up	8.00 up
Roosevelt	......	......	4.00 up	6.00 up
Savoy-Plaza	......	......	6.00 up	8.00 up
Taft	......	3.00 up	2.50 up	3.50 up
Vanderbilt	......	......	3.00 up	6.00 up
Woodward	......	......	2.50 up	3.50 up

Note: The Waldorf-Astoria, at which the reception, dinner, and dance will be held, will care for reservations to the extent of its capacity.

Facilities of the Engineers Club

Members may use the dining facilities of the Engineers Club on a cash basis. Guest cards for this purpose may be obtained at the Registration Desk. The Club will also be able to accommodate a limited number of members, the price of rooms ranging from $2.50 upward. Requests for reservations should be made in advance and addressed to Society Headquarters.

Information Desk

An information desk is provided in the Reading Room of the Society on the 15th Floor of the Engineering Societies Building to assist visiting members in obtaining hotel reservations and theater tickets, and in securing any desired information.

Your New York Address

At the Registration Desk a card file of those in attendance will be maintained, with information as to members' hotel addresses in New York. Members are requested to keep Headquarters informed as far as possible of their New York addresses so as to expedite the delivery of telegrams, telephone messages, and mail.

Order Tickets in Advance

Members who order tickets in advance will assist the Committee greatly by giving advance information to guide it in concluding arrangements. Ticket order blanks have been mailed to each member with the condensed program. No cancellation of tickets can be made after noon of Wednesday, January 21, 1942.

Regional Meeting Committee

This program has been prepared under the direction of the Committee on Regional Meetings, George L. Lucas, Vice-President, Am. Soc. C.E., Chairman, and H. M. Lewis, H. W. Hudson, E. P. Goodrich, and Lazarus White, Directors, Am. Soc. C.E.

Committee on Local Arrangements for the Annual Meeting

E. Warren Bowden, *Chairman*
E. L. Macdonald, *Vice-Chairman*

David G. Baillie, Jr.
Joseph W. Barker
John M. Buckley
F. R. W. Cleverdon
R. R. Graham
Ellis E. Paul
Julius W. Pfau
Glenn S. Reeves
Homer R. Seely
Sidney M. Shapiro
Elmer K. Timby

Junior Members

Michael M. Abrams
William J. Armento
Morris Atkin
Archie N. Carter
Willard LeRoy Colvin
M. Leonard Cohn
Arthur Dalphond
Roger H. Gilman
Laurence F. Granger
Benjamin P. Robinson
Franklyn C. Rogers

Ladies Committee

Mrs. E. Warren Bowden, *Chairman*

Mrs. David G. Baillie, Jr.
Mrs. R. E. Bakenhus
Mrs. Van Tuyl Boughton
Mrs. John M. Buckley
Mrs. George W. Burpee
Mrs. F. R. W. Cleverdon
Mrs. Dean Edwards
Mrs. Frederick H. Fowler
Mrs. Ernest P. Goodrich
Mrs. R. R. Graham
Mrs. Harold W. Hudson
Mrs. Harold M. Lewis
Mrs. E. L. Macdonald
Mrs. Ellis E. Paul
Mrs. Julius W. Pfau
Mrs. Glenn S. Reeves
Mrs. George T. Seabury
Mrs. Homer R. Seely
Mrs. Sidney M. Shapiro
Mrs. William J. Shea
Mrs. Elmer K. Timby
Mrs. Charles E. Trout
Mrs. Arthur S. Tuttle
Mrs. Lazarus White

Please call on the Committee on Local Arrangements or on the Secretary's Office for any service desired.

SOCIETY AFFAIRS

Official and Semi-Official

The Society in War Time

By Frederick H. Fowler

President, American Society of Civil Engineers

With the first flash news of the bombing of our island possessions there came to all of us a profound sense of relief, not that war had come, but that henceforth our path would be so clear that none could go astray. From the moment of the first attack until the hour of our final and certain victory, our personal welfare and the ordinary processes of life fade into the background, and our one aim must be to conquer.

This Society as a whole and its individual members have in the recent past, and will in the future, continue to contribute largely to this single aim. Already much has been accomplished, and for many months our organization has been serving in a variety of ways. It originated those technical preparedness measures that have been expanded into the general technical and non-technical activities of civilian defense. In recognition of his sterling service, the chairman of the Society's Committee on Civilian Protection in War Time was appointed by the Secretary of War to be chairman of the National Technological Civil Protection Committee, and has recently returned from England, where he was sent to observe and report on civilian protection methods developed there as the result of experience.

In recognition of the Society's leadership in this work, calls for assistance have come from various part of the country, and the Society has offered to governors and mayors the services of the committees on civilian protection that have been formed in each of sixty-four Local Sections.

Our professional records have been made available to those who need our aid. To accomplish this the Society has assisted in the collection of data on thousands of civil engineers, relating to their usefulness in war time, and this information is now incorporated in the National Roster of Scientific and Specialized Personnel. As a further service the records of more than 3,000 practicing engineering firms and individuals were placed in the hands of the Quartermaster General, the Corps of Engineers, and the Navy. Any demands for special technical service can be answered by reference to these two rosters, but the Society stands ready to render any further assistance that is needed.

Specific problems of widely varying character relating to defense or to preparation for war have been met as they were presented; some of them have called for the formation of small committees or for the appointment of individuals to act as representatives with those of other societies, to study various matters or to put in operation certain procedures. Some problems called for special studies or for services that have been performed by the Society's staff. Activities of this nature will doubtless be intensified in the future.

So much for the Society itself. What of its individual members? Many have gone into the armed services, others are rendering valuable professional aid as civilians in the War and Navy Departments and in defense agencies. Still others are engaged in the design and supervision of construction of cantonments, airfields, munitions plants, and many other facilities for the Army, Navy, Air Corps, and defense plants agencies. While hundreds of personal notes of such service have appeared in Civil Engineering, these include but a small part of those now patriotically serving. Literally thousands of civil engineers are contributing in important ways to the national effort, and in parts of the world as widely separated as the Poles.

They will continue to do so willingly and enthusiastically. Again, as throughout all its history, the Society, both as an organization and through its individual members, stands ready to give its utmost efforts to maintain our freedom in a world where, for the time being, there is all too little of that most highly prized commodity.

The wholehearted support of the Society was pledged to the President of the United States by official resolution of the Board of Direction at the summer Convention. I speak for the Society and for every member in renewing that pledge at this time of emergency.

One thing is certain—we are going on to Victory.

Society Prizes and Medals to Be Awarded

Following its usual custom, the Society will present prizes and medals at its Annual Meeting to be held in New York City, January 21–23, 1942. The oldest of these Society awards is the Norman Medal, which was endowed in 1872 by the late George H. Norman, M. Am. Soc. C.E., for an original paper that is considered an especially notable contribution to the profession. Next in importance is the J. James R. Croes Medal, established by the Society in 1912 and named for the first recipient of the Norman Medal.

In 1884 the late Thomas Fitch Rowland, Hon. M. Am. Soc. C.E., endowed the prize bearing his name, to be awarded for a paper that best describes in detail some accomplished works of construction. For the paper considered second in merit to that awarded the Thomas Fitch Rowland Prize, the Society in 1912 established the James Laurie Prize, which was named in honor of its first President.

In 1924 the Sanitary Engineering Division of the Society instituted and endowed the Rudolph Hering Medal, which goes to the author of the paper considered the most valuable contribution to the advancement of the sanitary branch of the profession.

The Arthur M. Wellington Prize for the best paper on some phase of transportation was established and endowed by the *Engineering News-Record* in 1921. Although it is not required that the recipient of this prize be a member of the Society, its award rests with the Society. In 1894 the Collingwood Prize for Juniors was established by the late Francis Collingwood, M. Am. Soc. C.E., on his retirement as Secretary of the Society. Papers eligible for this award must describe an engineering work or record an important investigation with which the author has been connected. Excellence of style is also a factor in the selection of the paper receiving this prize.

Finally, the Karl Emil Hilgard Hydraulic Prize was instituted in 1939 as a result of an endowment left to the Society for the purpose by the late Karl Emil Hilgard, M. Am. Soc. C.E., of Zurich, Switzerland. The prize may not be awarded more often than once in two years, and is to go to the author of a paper which is judged to be of superior merit, dealing with a problem of flowing water, either in theory or practice.

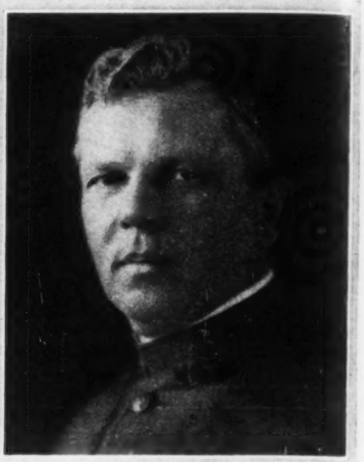
Biographical sketches of those receiving prizes or medals follow.

J. A. Van den Broek, M. Am. Soc. C.E., was born in Middelharnis, Holland, on March 6, 1885. In 1905 he came to the United States, where he was educated, graduating from the civil engineering school of the University of Kansas in 1911. Later (1918) he received the degree of doctor of philosophy from the University of Michigan. His early engineering experience included work on railway location and construction in British Columbia and Ontario. Upon his graduation he worked for a year with Hedrick and Cochran, consulting bridge engineers of Kansas City, and then (1912) was with the Boston Bridge Works. From 1912 to 1914 he was a designer in the bridge department of the Canadian Pacific Railway, with headquarters in Montreal. In the latter year he became an instructor at the University of Michigan. He advanced through the various professorial grades, finally becoming professor of engineering mechanics, which position he still holds. Professor Van den Broek has also lectured on the theory of strength at the Technical University of Delft, Holland, and the Illinois Institute of Technology in Chicago, as well as before such professional groups as the American Institute of Steel Construction and the Western Society of Engineers. The author of many articles that have appeared in the publications of the Society and other technical periodicals, he received a scholarship for his paper on "The Effects of Cold Working on the Elastic Properties of Steel" (Carnegie Memoirs, Iron and Steel Institute of Great Britain, Vol. 9, 1918).

Earl I. Brown, M. Am. Soc. C.E., was born in Douglas County, Georgia, on October 13, 1874. He was graduated from the public school in Carrollton, Ga., and from the U.S. Military Academy at West Point in 1894. Appointed a second lieutenant in the Corps of Engineers, U.S. Army, upon his graduation, he served with engineer troops during the Spanish-American War, and in the Philippine Insurrection from graduation until 1903, except for a short time as assistant to the district engineer at Wilmington, N.C. In 1906 and 1907 he also served with the Army of Pacification in Cuba. He

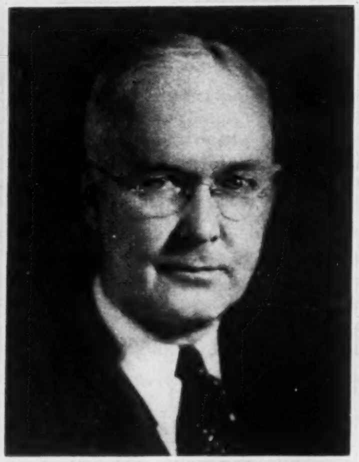
PRIZES AND MEDALS AWARDED FOR 1941

J. A. VAN DEN BROEK
Norman Medal for Paper, "Theory of Limit Design"



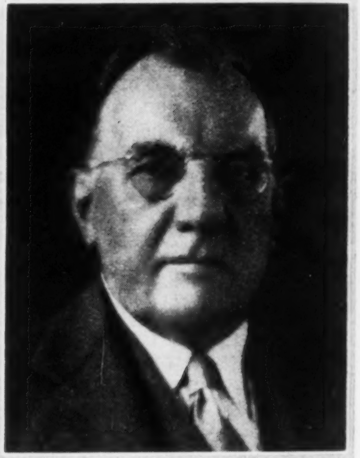
EARL I. BROWN
J. James R. Croes Medal for Paper, "Beach Erosion Studies"

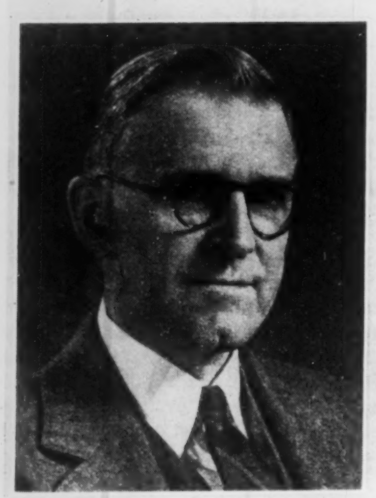
O. J. TODD
Thomas Fitch Rowland Prize for Paper, "The Yellow River Problem" (SIGURD ELIASSEN Is Co-Author of This Paper)



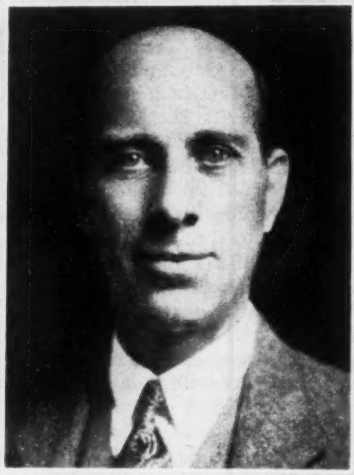
SAMUEL A. GREELEY
James Laurie Prize for Paper, "Sewage Disposal Project of Buffalo, New York"

FRED LAVIS
Arthur M. Wellington Prize for Paper, "Transportation Developments in the United States"





THOMAS R. CAMP
Karl Emil Hilgard Prize for Paper, "Lateral Spillway Channels"



THOMAS H. WIGGIN
Rudolph Hering Medal for His "Noteworthy, Painstaking, and Thorough Annual Reviews of Progress, Developments, and Trends in Water Supply Engineering and Water Works Practices Since 1933"

ELMER ROCK
Collingwood Prize for Juniors for Paper, "Design of a High-Head Siphon Spillway"

was graduated from the Engineer School of Application in 1905. From 1907 to 1911 he served as district engineer at Wilmington, being transferred in the latter year to Galveston, Tex., and in 1912 to Montgomery, Ala. In 1915 Colonel Brown was appointed chief of the Washington Office, and general purchasing agent of the Panama Canal, in which capacity he continued until the entry of the United States into the World War. In 1917 he organized and commanded the 307th Engineers of the 82d Division and the 317th Engineers of the 92d Division, accompanying the latter overseas and commanding it through front line service in the Vosges Mountains and in the Meuse-Argonne Offensive. He later served as engineer of the Vth Corps, and then commanded the 21st Engineers (light railway). After his return to the United States he was assigned to river and harbor duty, as district engineer at Cincinnati, Ohio, and from 1921 to 1927 was district engineer at Wilmington, Del., where he reconstructed and modernized the Chesapeake and Delaware Canal. He was returned to military duty in 1927, and served as Engineer VIII Corps Area, at Fort Sam Houston, San Antonio, Tex., until 1930, when he was assigned as district engineer at Philadelphia, Pa. In 1933 and 1934 he served in Washington, D.C., as a member of the Board of Engineers for Rivers and Harbors and of the Beach Erosion Board. He was then assigned as division engineer of the South Atlantic Divison, continuing until his retirement at the statutory age limit in 1938. After his retirement he resided in Wilmington, where he engaged in research and consulting practice. In 1940 he was recalled to active duty for the emergency, and assigned as district engineer at Wilmington. He is the author of various technical articles, and was the recipient of the Society's James Laurie Prize in 1932 for a paper on "The Chesapeake and Delaware Canal," and of its J. James R. Croes Medal in 1933 for "Flow of Water in Tidal Canals."

Oliver J. Todd, M. Am. Soc. C.E., was born in Colon, Mich., on November 1, 1880, and graduated from the University of Michigan in 1908 with the degree of bachelor of science in civil engineering. From 1908 to 1909 he was with a firm of engineers on building construction in San Francisco, and from the latter year to 1917 was on the staff of the City Engineer of San Francisco. In this employment he was in charge of the early hydrographic studies on the Hetch Hetchy Water Supply and was connected with many of the early surveys of that project. During the same period he served as an assistant engineer on the Twin Peaks Tunnel construction, paving, and sewer work for the city. In September 1917 he entered the Army as a captain, serving 22 months in France—first with the 20th Engineers and, later, with the Department of Construction and Forestry. He was in active charge of construction of large hospital centers and was cited by General Pershing for rapid construction of one of the larger masonry reservoirs and other water supply facilities. On Mr. Todd's return from France he accompanied John R. Freeman, Past President of the Society, to China, where he served as principal assistant engineer in handling surveys and estimates in connection with studies of the Grand Canal in Shantung Province. Later, during a severe drought famine, he was placed in charge of the extensive work relief program of the American Red Cross for Shantung Province and, in this capacity, constructed 500 miles of motor roads. As chief engineer for the Asia Development Company of Shanghai, China, he made investigations and estimates for water supplies, roads, and other facilities in north and central China and carried on a construction program of road and dike building in 16 counties of Shantung Province. Following this he was made chief engineer of the newly organized China International Famine Relief Commission and remained in this post from 1923 to 1935, planning and carrying out engineering projects in 12 of China's 18 original provinces. The latter work included river control, irrigation, and road building and extended from Mongolia to Yunnan Province in the southwest. From 1936 to 1937 he was consultant on Yellow River problems, both for the province of Shantung and the Chinese National Government, through the Yellow River Commission. During the same period he was also consulting engineer on flood problems for the American Advisory Committee in China. The Japanese-Chinese War in the summer of 1937 closed the Yellow River work in which Mr. Todd was engaged and he returned to America in the early part of 1938. He is now on the staff of the Bureau of Reclamation, engaged in studies of silt, flood, and other problems of the Middle Rio Grande. During much of the time spent in China he was a major of Engineers in our Army Reserve. While in China Mr. Todd wrote for technical and other publications in China and America, much of this material having been reprinted in a volume entitled *Two Decades in China*. His numerous technical affiliations include the Association of Chinese and American Engineers, of which he was secretary for seven years, and the American Institute of Consulting Engineers.

Sigurd Eliassen, Assoc. M. Am. Soc. C.E., was born in Christiana, Norway, in 1885. In 1908 and 1909 he was assistant surveyor on harbor surveys in northern Siberia for the Russian government and he was with the Chinese Maritime Customs Coast Survey Department from 1910 to 1916. In the latter year he came to this country and entered the University of Minnesota as a special student in civil engineering, graduating in 1918 with the degree of bachelor of science in civil engineering. He immediately returned to China and entered service on the engineering staff of the Chihli River Commission at Tientsin, where he served until 1929, as an assistant engineer on survey work and mapping, being in charge of the preparation of a set of excellent topographical maps of much of Chihli (now Hopei) Province. From 1929 to 1930 he was engaged in river studies, chiefly on the Yangtze, by Hupeh Province, and from the latter year to 1933 was assistant engineer on irrigation and road projects for the China International Famine Relief Commission in Suiyuan and Shensi provinces. From 1933 to 1937 he was in charge of surveys and hydrometric work for the Yellow River Commission and, in that capacity, organized and supervised the stream flow and silt studies made by that organization. Because of the Japanese-Chinese War in 1937 he was obliged to leave his Yellow River work. The following spring, March 1938, he left China for Norway. Since that time he has been engaged with a firm of consulting engineers with offices in Oslo. While in China Mr. Eliassen wrote numerous papers on river problems and climatology of China for publication in the Journal of the Association of Chinese and American Engineers of which organization he was an active member.

Samuel A. Greeley, M. Am. Soc. C.E., was born in Chicago on August 20, 1882. He was graduated from Harvard College in 1903 with the bachelor of arts degree, and in 1906 received a B.S. degree in civil engineering from the Massachusetts Institute of Technology. In 1904 he joined the staff of Hering and Fuller, for whom he spent five years on design, reports, and supervision of construction of sanitary engineering works. In 1909 he became resident engineer in charge of the construction of a refuse disposal plant for Milwaukee and, later, was superintendent in charge of operation. During this period he went to Caracas, Venezuela, as resident engineer in charge of investigations for water supply and sewage disposal for that city under the late James H. Fuertes, M. Am. Soc. C.E. From 1912 to 1914 he was assistant sanitary engineer in the Sanitary District of Chicago. In 1914 he established a practice under the firm name of Pearse and Greeley, which was changed in 1922 to Pearse, Greeley and Hansen and, in 1932, to Greeley and Hansen. During the World War Mr. Greeley was consulting and supervising engineer on the construction of Camp Custer, Mich., having charge of construction work in the field as well as of the design of water supply and sewage disposal works. He was also sanitary engineer for the U.S. Shipping Board and investigated sanitary engineering problems in shipyard communities on the Pacific Coast and along the Great Lakes and the New England coast. His important work includes the design and construction of water supply and sewage and refuse disposal projects for numerous municipalities throughout the country. He has also served as a member of the boards of engineers in connection with sewage disposal projects for Washington, D.C., Boston, Los Angeles, New York, Toronto, and other cities, and was a consultant for the Los Angeles County Sanitation Districts. His firm served as architect-engineers for the construction of Camp Forrest, Tenn. With the late Rudolph Hering, M. Am. Soc. C.E., Mr. Greeley was co-author of *Collection and Disposal of Municipal Refuse*. He is a member of the American Water Works Association, the Western Society of Engineers, the American Society for Testing Materials, and numerous other technical organizations.

Thomas H. Wiggin, M. Am. Soc. C.E., was born at Exeter, N.H., and educated at Massachusetts Institute of Technology, receiving the B.S. degree in 1895. From shortly after his graduation to 1903 Mr. Wiggin was with the Metropolitan Water Board of Massachusetts; on the design of the Little Falls (N.J.) filter plant; and on surveys and estimates for the Additional Water Supply

Commission of New York. He then became principal division engineer in charge of the design and construction of a new water supply for the City of Pittsburgh, remaining in this capacity until 1906. From the latter year to 1919 he was senior designing engineer for the New York Board of Water Supply on the Catskill supply. For the last two years of this period he was on leave from the Board as officer in charge of water supply and sewerage with the S.O.S., A.E.F. in France, attaining the final rank of lieutenant colonel in the Corps of Engineers. For his services he received a citation from the U.S. Army and was decorated by the French Government. Mr. Wiggin then went to China as acting chief engineer of the China Grand Canal on studies for improving irrigation and navigation. During this period he also served as consultant on water-supply problems to the City of Amoy, China, and to the Famine Relief Commission on the study of irrigation in the Province of Shansi, China. Returning to New York City in 1921, he established a consulting practice which he maintained until 1927. From the latter year to 1931 he was president and chief engineer of the Public Works Engineering Corporation, New York, in charge of water supply improvements for about a hundred water companies, and from 1931 to 1933 was vice-president and chief engineer of the Trojan Engineering Company (a merger of the Public Works Engineering Corporation and other engineering companies). Since 1933 Mr. Wiggin has been in practice in New York City as consultant to many of the companies. He is responsible for several innovations, in the construction of the Catskill system—including many features of the pressure tunnels, the large cement lined and concrete covered steel pipes—and for the first use of tar enamel for protecting steel pipes. He served as associate editor-in-chief of the fifth edition of Merriman's *Civil Engineers' Handbook* and is the author of a number of monographs and articles on water supply and other subjects. Since 1926 he has been chairman of the Sectional Committee on Specifications for Cast Iron Pipe and Fittings.

FRED LAVIS, M. Am. Soc. C.E., was born at Torquay, Devonshire, England, in January 1871, and was educated at St. Luke's School. He came to the United States in 1887, and soon after obtained a position as rodman in a surveyor's office in Boston. He later worked on the Boston and Maine, the New England, and the New York New Haven and Hartford railroads. In the meantime he had also been to Cuba and to Colombia. He was engaged in railway work, location, and construction in the United States and in Latin America up to 1909, when he established a consulting practice in New York City, specializing in transportation. He was later chief engineer of the Argentine Railway in Argentina; investigated railways in Spain, Italy, and various countries of Latin America; and had charge of the location and design of the superhighway from the Holland Tunnel to Elizabeth, N.J., now Route, 25. He was consulting engineer for, and later on, president of the International Railways of Central America. He investigated a proposal for an international highway in Paraguay and, since 1938, has been consultant to the government of Venezuela on transportation problems in that country. He recently prepared a report on "Internal Transportation and Intercommunication in Latin America" for the National Defense Council. He is the author of *Railway Location Surveys* (1906) and *Railway Estimates* (1913), and has been an extensive contributor to engineering literature on subjects relating to transportation economics and finance. He has also lectured on these subjects at Rensselaer Polytechnic Institute and at Yale and Princeton universities.

ELMER ROCK, Jun. Am. Soc. C.E., was born in Cleveland, Ohio, on November 13, 1910, and graduated from the Case School of Applied Science in 1932 with the degree of bachelor of science in civil engineering. After graduation he attended John Huntington Polytechnic Institute, completing courses in soil mechanics and statically indeterminate structures. In 1933 and 1934 he was engaged in building construction work in Cleveland, Ohio, and in 1935 was employed by the Case School of Applied Science to work on hydraulic model tests of spillways and outlet works structures for flood control dams. Since the latter year Mr. Rock has been in government service, working as a civilian engineer with the Corps of Engineers, U.S. Army. His first assignment was on the Muskingum River Flood Control Project in southern Ohio, where he was engineering assistant in the field office of Mohawk Dam. He was later made executive engineer on the construction of Senecaville Dam. In December 1936 he was transferred to the U.S. Engineer Office in Providence, R.I., where he worked on hydraulic design problems in connection with the Connecticut River Flood Control Project. Recently he was transferred to the South Atlantic Division Office in Richmnod, Va., to work in the Defense Construction Section on drainage, water supply, and sanitary engineering. While in Providence Mr. Rock was an active participant in the affairs of the Junior Group of the Providence Section of the Society.

THOMAS R. CAMP, M. Am. Soc. C.E., was born in San Antonio, Tex., on November 5, 1895. After graduation from Texas Agricultural and Mechanical College in 1916 with the degree of bachelor of science in architectural engineering, he joined the Texas Power amd Light Company. In September 1917 he joined the staff of E. N. Noyes, M. Am. Soc. C.E., Texas consultant on the construction of Camp Travis, and in December of that year enlisted in the army. He served in France at the Saumur Artillery School, the Heavy Artillery School at Angers, and as an officer with the 67th Regiment Coast Artillery Corps. In 1921 he joined the staff of the late John B. Hawley, M. Am. Soc. C.E., as resident engineer on the construction of a water filtration plant at Breckenridge, Tex. He was, also, resident engineer on the construction of a complete sewerage system and paving program for this city and was city engineer from 1922 to 1923. In the summer of 1923 he was employed in the Fort Worth office of John B. Hawley, and from 1923 to 1925 attended Massachusetts Institute of Technology, receiving the master's degree in civil engineering. In 1925 Professor Camp became associated with Spoon and Lewis (later Spoon, Lewis and Camp), consulting engineers of Greensboro, N.C., and engaged in a general municipal engineering practice with this firm until 1928. He then became chief designing engineer for the late Alexander Potter, M. Am. Soc. C.E., New York City consultant, and in this capacity was in charge of the design of projects aggregating about $5,000,000. In 1929 he accepted an appointment as associate professor of sanitary engineering at Massachusetts Institute of Technology, which post he still occupies. Professor Camp has been actively engaged in research and development in hydraulics, sedimentation, filtration, coagulation, and other phases of sanitary engineering, and is responsible for the development of the porous plate filter bottom, a new type of grit chamber control, and recent improvements in the hydraulic analysis of water distribution systems. He is the author of numerous papers on sanitary engineering subjects and of sections dealing with water supplies, distribution, and treatment in a new *Handbook of Applied Hydraulics*, edited by C. V. Davis, to be published shortly by McGraw-Hill. He is a member of Sigma Xi and of numerous engineering and technical societies, and is at present a director of the Boston Society of Civil Engineers.

Honorary Membership Awarded to Five Engineers

RALPH BUDD

TO JUDGE Ralph Budd from social contacts alone—say at a Society meeting—might be misleading. He would be quiet and friendly, interested and interesting, a genial sort of person. But you would never suspect, as one stranger to another, that you had been talking to one of America's leading railroad executives—to a really national figure in transportation. Ralph Budd is that way; he maintains no false front. He has progressed fast and far in a great calling and it has been by sheer ability without bombast.

Following a boyhood and education in Iowa, he has devoted a lifetime to railroading. For short periods he was with the Great Western and Rock Island roads. There he met John F. Stevens, an event that colored his whole life work. He and Mr. Stevens became life-long friends although a quarter of a century separated their ages.

Through Mr. Stevens he went to Panama and became chief engineer of the Panama Railroad. One of his first problems there was to get the new road above the water level of the proposed canal. In his field surveys there was a good deal of clearing to do,

Ralph Budd

and he soon found that the brush grew up behind so quickly that progress was slowed. He solved the problem by locating only the ridges and hollows, as of course these were the features which controlled the final route.

He followed Mr. Stevens back to the States and served under him in the Northwest. There he met James J. Hill, whose influence upon his life was to be quite controlling. Soon he was chief engineer of the Great Northern, then vice-president, and in 1919, at the age of 40, president of that great system. During his 12 years in this capacity, he authorized the expenditure of 160 millions of dollars in improvements, the largest of which were the new Cascade Mountain line, including the 7.79-mile tunnel, and the extension to Bieber, Calif. In 1932 he was "promoted" to the presidency of the Burlington Road. Most spectacular of his successes in this position was the development of light-weight Diesel-powered streamlined trains, a family of silver "Zephyrs." His success, from the very first, following the introduction of these trains in 1934, has led to wide imitation by other roads. Many of the interesting details of this development he has shared with readers of Civil Engineering in three articles. The latest acknowledgment of his administrative and executive ability came in his appointment as Transportation Commissioner for the United States defense program in May 1940.

Few men understand the West and its problems better than Mr. Budd. He knows railroad men far and wide; he is at home with cattlemen and speaks their language; in the company of manufacturers and executives, he gives and receives valuable advice. A trip with him through the western country is revealing of the extent and depth of his knowledge. He once arranged such a trip for Society officers and others. Twelve cars in the train were filled with guests, some from universities and some from historical societies, many from the engineering profession. The high point was the dedication of the monument to John F. Stevens at Marias Pass in the Rockies, followed by a memorable dinner, given by Mr. Budd to his guests at Lake MacDonald in Glacier National Park.

Following the disastrous Republican River flood of 1935, Mr. Budd planned a trip for the directors of the Burlington Road to see the rebuilding and note the conditions following the restoration. The trip was arranged for five or six days of daylight traveling. Mr. Budd personally supervised the preparation of a brief folder for each day's trip, informing each director of the improvements to be visited, with pertinent details. Mr. Budd is particular in such matters; he does not do things by halves.

On one busy trip over the line with some of his engineers, he was about to get out of his car when he was met at the steps by two small boys. They wanted his autograph. Immediately he turned around and went back into the car with them and talked with them before signing their slips. That is characteristic of the easy way in which he greets and meets people.

He is apt to pick the important or key conditions and try to solve them, leaving the details for action by others. On his trips he is interested in all sorts of things, the departments of his road and of other roads, the various means of transportation, local improvements of all sorts, agriculture, livestock, manufacturing, and every other factor in transportation.

He is a trustee of the James Jerome Hill Reference Library in St. Paul. One evening he took a group of his friends to see Mr. Hill's private library there. He explained to them the furniture in this special room, part of which had been used by Mr. Hill himself. He also explained the different parts of the library, taking down here and there a book and turning to familiar pages. Only time cut short this delightful talk, an interesting insight into Mr. Budd's wide knowledge.

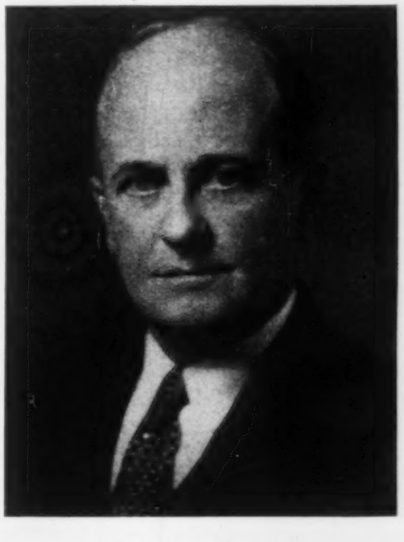
If he has one hobby it is work, and acquainting himself with the details surrounding the matter at hand. He also has lighter avocations. Horseback riding is his favorite sport; it reminds him of happy days as reconnaissance engineer in the Northwest. He is a baseball and football fan. He is also an ardent collector of Northwest americana—diaries and reports of explorers, Indian objects, engineering relics, and transportation history, the latter as exemplified by his articles in Civil Engineering during 1940 on transcontinental railroading.

He has long been interested in Society work. In addition to his contributions to Civil Engineering, he served one term as Director. Other honors have come to him in abundance. The most notable, from the engineering standpoint, were the John Fritz Medal and the Washington Medal, both awarded in 1941. He is amply qualified for the distinction of Honorary Membership in the Society.

WILLIAM KELLY

It is not the lot of many engineers to become preeminent in two widely different types of service. William Kelly's achievements in the fields of military engineering and business are a tribute to his abilities, natural and acquired.

Among his distinguished American ancestors were his grandfather, Benjamin Silliman, a noted scientist and professor of chemistry and natural history at Yale. An earlier ancestor in the same line helped to found the Sheffield Scientific School. He is also a descendant of John Trumbull, first governor of Connecticut, and of John Alden and Priscilla Mullins of Mayflower fame. An uncle, William Kelly, was president of the American Institute of Mining Engineers.



William Kelly

In college William Kelly made a fine scholastic record. After a year at Yale he entered the Military Academy at West Point, from which he graduated second in his class. Commissioned in 1899, he served as an officer of the Corps of Engineers in various grades until 1928, when he resigned with the rank of Colonel.

In the Corps he held many important assignments—from Long Island Sound to San Francisco Harbor, and even to Manila Bay in the Philippines. Meanwhile he had completed a postgraduate course in engineering at the Engineering School of Application in Washington.

In 1917 Colonel Kelly went to France as commanding officer of the 117th Engineers, 42d Division. There he took part in all the engagements of the Division, including three major ones—the Chateau Thierry offensive, the defense against the last great German drive just east of Rheims, and the San Mihiel offensive, Compigène. In addition he was chief engineer of the 4th Army Corps, commander of several Base Sections in both France and Belgium, and deputy chief of staff of the A.E.F. in France.

A number of high points punctuated his Army service. For example he was assistant to the American Peace Commission and in this capacity made a survey of navigation on the Danube, collecting inventories of floating plants and wharf facilities on various streams. This was in preparation for the work of the United States Arbitrator provided by the Treaty of Versailles.

Following the World War, he continued to give valuable service to the Corps. He had charge of river and harbor improvements in the San Francisco district, was secretary and disbursing officer of the California Debris Commission, and a member of the San Francisco Harbor Line Board. Among his other assignments were membership on the Joint Board of Engineers of the St. Lawrence River Project, and chairmanship of the Board on Reservoirs for Mississippi River Flood Protection.

It happened that he was stationed in San Francisco at the time of the earthquake and fire. So it was his privilege to take charge of part of the relief and much of the housing work.

From 1920 to 1925 Colonel Kelly served as the first chief engineer of the Federal Power Commission. Since this was a new agency, there were few precedents to guide it. The fact that it has maintained such a generally successful record is due in large part to his initial work. During his incumbency, studies were made of most of the important streams of the United States, in carrying out the terms of the Federal Water Power Act.

After this long period of distinguished service in the Corps of Engineers, Colonel Kelly went into private practice, first as director of engineering for the National Electric Light Association in New York City, and a year later, in 1926, as officer in the power companies serving western New York. In the engineering and business management of this public utility field he has had a success comparable to that in the Army. At present he is president and director of the Buffalo, Niagara, and Eastern Power Corporation, the largest power utility company in New York State and one of the largest in the country.

These accomplishments have received acknowledgment in various ways. He has received the U.S. Distinguished Medal for Service in France, and has been made an officer of the Legion of Honor of France. For his paper, "The Colorado River Problem," the Society awarded him the James Laurie Prize in 1925.

His personal qualifications are quite in keeping with his technical ones. Character and integrity stamp his every activity. He is clean-cut in appearance, incisive in action. In him are united firmness, initiative, foresight—all overlaid with kindliness. He is admired and beloved by a large circle of friends and associates.

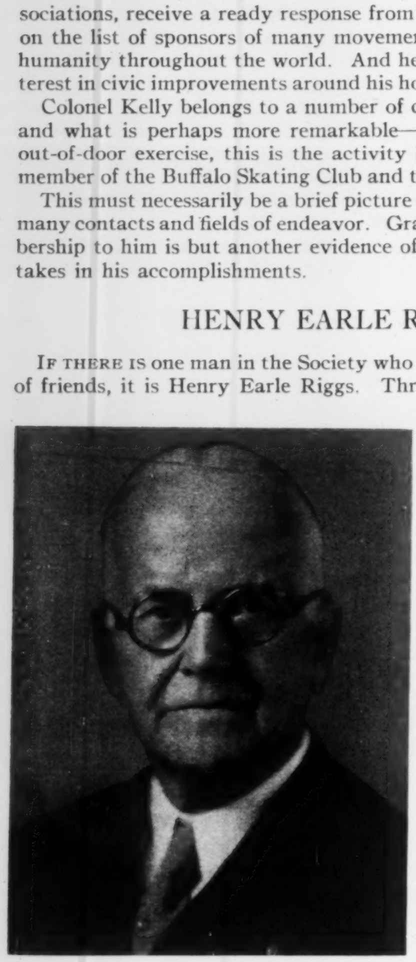
Like many of his forebears, Colonel Kelly is civic minded. Calls for social service, in the Board of Trade, or on various planning associations, receive a ready response from him. His name is found on the list of sponsors of many movements for the betterment of humanity throughout the world. And he does not fail to show interest in civic improvements around his home city of Buffalo.

Colonel Kelly belongs to a number of clubs. He is an ardent—and what is perhaps more remarkable—a proficient golfer. For out-of-door exercise, this is the activity he prefers. He is also a member of the Buffalo Skating Club and the Buffalo Athletic Club.

This must necessarily be a brief picture of a man distinguished in many contacts and fields of endeavor. Granting of Honorary Membership to him is but another evidence of the pride the profession takes in his accomplishments.

HENRY EARLE RIGGS

IF THERE IS one man in the Society who is most noted for his host of friends, it is Henry Earle Riggs. Through a long professional life he has been acquiring them year by year, and never losing one. He surely has a genius for friendship, and he has exercised it in all phases of his life—in his teaching, in his consulting work, and in his long and notable affiliations as an officer of the Society. It may seem an idle gesture to try to picture one who is already known so widely and so well. Fortunately, his is a personality that will fully bear inspection—such an examination serves only to emphasize his fine qualities.



HENRY EARLE RIGGS

In a professional way also he has been eminent. Following graduation from the University of Kansas in 1886 he held a variety of positions, mostly on railroad work in the Middle West. After ten years of this, he settled down for 15 years or more in partnership with W. J. Sherman at Toledo, Ohio. Work on railroads, water works, valuation of public utilities, waterways engineering, and similar activities occupied his professional energies.

Then in 1912 began what was perhaps his greatest contribution to the profession, his work as professor of civil engineering and later as head of the department at the University of Michigan. Since 1930 he has held the title of honorary professor. Under his direction the department grew and prospered. Its illustrious graduates were to be found all over the country, their careers followed with keen delight by their college professor.

Meanwhile Dr. Riggs was sought out for many important consulting assignments. Railroad work was prominent among these, but there were also numerous valuations of gas, electric, railroad, and street railway properties, many of them in Michigan. The railroad systems that sought his advice, particularly in connection with federal valuation, included a dozen of the most prominent in the country. The fact that he was at times retained on both the public and the private sides of utility valuation cases, in addition to serving as adviser to the court, witnesses to his standing and his reputation for fair mindedness.

It is now almost fifty years since he became affiliated with the Society. Since 1932 he has served almost continuously as a member of the Board of Direction—successively as Director, Vice-President, President, and Past-President. It is doubtful if any member of the Society has ever been a more devoted or earnest member of its governing board or has given more freely of his time, energy, and resources to the best interests of the organization. Illustrative of this is his record of 75 addresses made in various parts of the country during the first few months of his term as President. In these visits to Local Sections and Student Chapters he traveled throughout the United States and even to Hawaii.

No one can think of Dr. Riggs without being reminded of his partner for so many years, for Mrs. Riggs is almost as well known throughout the Society as he is. Her record of attendance at Society meetings is almost as good as his—which is practically perfect. At one time he suffered a broken leg. Most people would feel that that was sufficient reason for giving up every activity, but it could not keep Dr. Riggs down. He and his wife appeared as usual at the next Board meeting—he in a wheel chair with a nurse. Next he was promoted to crutches and finally to a cane. He still uses the cane.

Any good American parents might be as proud as they are of their family—children and grandchildren. Years ago, at a private dinner, his hostess twitted him about his family. But he came right back and gave her fair warning that he could name all his children in order of age, but that she must not insist upon his remembering their birthdays. Perhaps this is why he now carries a notebook containing all significant dates. He is quite an expert on the family tree and has written two books on the subject, one on his own, and one on Mrs. Riggs' forebears. At latest account, the Riggs family comprises a total of six children and nineteen grandchildren.

It goes without saying that Dr. Riggs has received many recognitions of his character and attainments. Many social and honorary societies have sought his membership. In 1937 the University of Michigan bestowed upon him the degree of Doctor of Engineering.

Still, in spite of his years, he retains the same keen interest in all his friends and their welfare and in the problems of engineers. He is almost as proud of the "boys" who graduated under him as he is of his own family. Even outside the Society, all engineering groups know that they can turn to him for advice and help on matters relating to professional organization. An illustration of this general interest in the profession is the part he played recently in the formation of a new organization in Michigan, to include architects, contractors, and equipment manufactuers as well as engineers, with the purpose of solving defense and other professional problems. To this movement he gave generously of time and counsel.

Nowadays, according to his own statement, he is "principally engaged in being an old man." If so, he does it with grace. But he cannot fool his friends. They see the same firm step, the same twinkle in the eye, the same ready reference to, or recollection of, his experiences of years ago. With all his honors, among which the latest is Honorary Membership in the Society, Dr. Riggs will never seem old.

JOHN LUCIAN SAVAGE

John Lucian Savage is one of those engineers whose life history could be epitomized in a few words because it has been so uniform, or described in great detail because it has involved such wide and notable accomplishments. With one organization for almost his entire career, he was responsible for the design of structures which have made him known throughout the country and even throughout the world.

Born in Wisconsin, he remained there until his graduation from the University in 1903. Thereafter he immediately affiliated himself with the U.S. Reclamation Service. Then, for a period of eight years, from 1908 to 1916, he was associated with the late A. J. Wiley in Boise, Idaho, in irrigation and hydroelectric engineering. Except for this interval, his entire professional career has been in the service of the Bureau of Reclamation in its period of greatest expansion. Since 1924 he has been chief designing engineer, in charge of all civil, electrical, and mechanical design. The vast enterprises undertaken, culminating in Boulder, Grand Coulee, and Shasta dams, not to mention a wide variety of incidental work in design, indicate the degree of responsibility John L. Savage has carried through the years.

John Lucian Savage

While he has been with the Bureau, scores of dams have been designed under his supervision, as well as a wide variety of other projects. Many were of record-breaking size, dwarfing earlier construction. In cost, the dams alone came to well over six hundred million dollars. Incidental structures and other types of work, such as the All-American Canal, would raise the total another hundred million. Then there is the work for which he was loaned outside the Bureau—for the TVA, for the Panama Canal Zone, for Puerto Rico and the West Indies, to mention only a few. In sum total these projects probably exceed a billion dollars. Few engineers in history have carried such responsibilities.

A natural question is how he came to enter the work in which he has been so successful. The answer is that it almost did not happen. The opportunity to undertake reclamation work came just when he had begun his professional life as a teacher at Purdue University. His conscience would not let him disappoint the University by changing to the reclamation work. Fortunately, however, there were some broad-visioned administrators who were willing to release him. Doubtless he would have made an excellent teacher, but the wisdom of his change has been justified by the result.

A man of simple habits, Mr. Savage seems to take his recreation in work. He keeps in the best of condition, not by the device of golf, but by frequent field and inspection trips in the open. He has the advantage of dividing his time between his office in Denver and his visits on construction, and in both of these environments he is perfectly at home.

His friends tell one story of his sportsmanship. On an early job some of the engineers, including Mr. Savage, promised themselves that they would take a swim in the upper Snake River once every month. When December came the others got their duty over with promptly but he held out for milder weather. Finally came the last afternoon in the month, which was even colder than the rest. A large audience gathered and they were not disappointed when he took a full, if not a prolonged, dip.

The inner satisfaction of doing such mighty work as he has done is probably much greater than the material recompense. Mr. Savage describes this type of satisfaction graphically by a comparison. When he reported for his first work in the field with the Bureau, he found a tent for headquarters, and nearby a small yellow flag indicating the presence of smallpox. Now the smallpox has gone and many square miles of the sagebrush plain have given way to irrigated lands and permanent homes. These are the satisfactions of the real builder.

Mr. Savage's services have not been without recognition. Honorary societies have welcomed him to membership. He received the honorary degree of Doctor of Science from his alma mater, the University of Wisconsin, in 1934. The Colorado Engineering Council in 1937 gave him its Gold Medal Award for distinguished service. In the same year he was singled out to go to London and deliver a lecture on the Boulder project as guest of the Institution of Civil Engineers of Great Britain. His latest honor—a consulting assignment in Australia—comes in recognition of his former international consulting work. He left San Francisco in November and later is to advise the government of Punjab, India. This service will prevent his attendance at the presentation of Honorary Membership in the Society at the 1942 Annual Meeting.

Doubtless the one thing that he esteems most is his associations in the Bureau of Reclamation. To many, "Jack" Savage is a confidant, companion, and friend. His simplicity, his kindliness, and his readiness to lend aid and encouragement have endeared him to all. His qualifications as a man no less than his accomplishments as an engineer make him an outstanding recipient of Honorary Membership.

HENRY MATSON WAITE

More versatile than most engineers, Henry Matson Waite has succeeded in a wide range of engineering service—transportation, mining, municipal, army, and government. His achievements in these varied fields bear significantly on his qualities of technical skill and practical judgment.

He was born and raised in Ohio and much of his later important engineering work was done there. Following his studies at the Massachusetts Institute of Technology, he spent twenty years in railroad work, distributed between Ohio and Florida. At the conclusion of this period he was for several years superintendent of the Seaboard Air Line Railway, one of the greatest systems of the Southeast.

Henry Matson Waite

Then followed an interval as vice-president and chief engineer of the Richfield Coal Corporation in Virginia, which he left to accept the position of chief engineer of the City of Cincinnati, starting in 1912. Shortly thereafter the Miami Valley in Ohio suffered a great flood and the City of Dayton found itself in serious difficulties. Seeking someone who could bring order out of chaos, it turned to Mr. Waite, and in 1914 he became its city manager. So successful was this experiment in city government that Colonel Waite became a national figure. His administration was used as a telling argument in favor of engineers as city managers. The peculiar difficulties of the locality and the period only made his success the more striking.

After four years, Mr. Waite resigned his post to offer himself to the Government in the World War. As a Colonel he gave valiant service in a number of ways, but especially as deputy director general of transportation in the A.E.F. In recognition of his military accomplishments he was awarded the Distinguished Service Medal by the United States and was made an officer of the Legion of Honor of France.

For a number of years following the war he was in private consulting practice in New York. In 1927 he was called upon to give one of the greatest services of his career in the development and construction of the Cincinnati Union Railroad Terminal. There the various roads entering Cincinnati were brought together in one great center with yards attached, and all the rearrangements that were involved. Only those who were conversant with the intolerable conditions that originally existed can appreciate Colonel Waite's great contribution. Organization, planning, and construction were in his hands. When this historic terminal, costing forty millions, was completed in 1933, six months ahead of schedule and within the estimated cost, it immediately took its place as one of the great transportation centers of the country.

Since completion of the terminal, Colonel Waite has been largely in government service. As Deputy Administrator with the PWA in 1933, he organized and developed a program of over three billion dollars. He then was called back to Cincinnati, where he inaugurated, conducted, and completed the work of the Unemployment Survey. Later positions of responsibility in the government have been those of technical adviser to the National Resources Board and the National Youth Administration, and more recently consultant to the Bureau of the Budget. In the meantime he served as chairman of the Chicago Subway Committee.

One characteristic of Colonel Waite's engineering work is thoroughness. Before reaching a decision, he investigates and experiments even with what might be regarded as minor details of the work under his charge. For the Cincinnati Terminal, for example, he spent many hours trying out various types and arrangements of lighting. So with all the other details, with the result that this terminal is renowned for both utility and beauty.

His attention to practical, everyday affairs has not blinded him to things of the spirit. He maintains a lively interest in music, art, literature, and the theater. To a mind thus endowed, he has added an agreeable personality. In his attitude toward others he is broad minded. He is friendly in his relations with his associates and is popular in the communities where he has lived.

He is also blessed with a fine administrative shrewdness, which enables him quickly to recognize the ability of associates. He takes generous advantage of every possibility in advancing them and the work in hand. Being thorough himself, he demands a like contribution from others. He never expects and he never accepts less than the best. As especially illustrated in his work on the Cincinnati Terminal, his thoughts and planning are forward looking, always based on future needs and possibilities rather than solely on immediate considerations. He expresses his ideas in a direct and fearless manner that cannot be misunderstood.

In the days of his vigor, and more recently through a period of illness, Colonel Waite has been greatly admired for his engineering accomplishments and for his qualities as a man. A great engineer, a careful planner, and a fine public servant is now recognized in the award of Honorary Membership in the Society.

Why Attend Society Meetings?

AS THE Annual Meeting of the Society in New York approaches, it may be in order to call attention to one of the chief opportunities that every such gathering presents. A member may attend primarily to hear the technical papers—at least that is likely to be the reason he gives for the expenditure of his own or his firm's time and money. Actually, however, the opportunity to see his old friends and to make new ones is not far from his mind, and it may be the compelling motive.

One prominent past-officer of the Society, when he attends a Society meeting, spends most of his time sitting in the lobby of the headquarters hotel. And instead of reading the paper he is looking for his friends. The reason he gives is that he can read the papers when they are published but can only see his friends then and there. This man's cultivation of his acquaintances is perhaps one good reason for his success in the profession.

But the man who attends his first Society meeting, especially if he is inclined to be a trifle self-conscious, or "introvert," may not discover this truth. He is apt to "flock by himself" and thus to miss one of the greatest returns from the effort he has made to be present.

An example of this was observed at a recent Annual Meeting. A visitor approached one of the headquarters staff on the evening of the first day. He had come from out of town, and frankly he was having a very unpleasant experience. No one had taken the pains to speak to him. Inquiry revealed, also, that on his part he had not attempted to speak to anyone. So he was going back home that night. Finally he was induced to stay one more day—and to promise that the next morning he would introduce himself to the first five engineers he met and ask each one about his work and interests.

The next evening when he came to report, he had a very different story to tell. He was having a fine time and was discovering that engineers are very sociable after all. As far as he was concerned, the meeting had become a great success and he was already looking forward to attending the next one.

A well-known engineer in New York who makes a point of meeting people and has a host of freinds, belongs to a prominent club in the city—one that is very strict in admission to membership. It has an unwritten rule that "no one needs an introduction to anyone he encounters in the clubrooms." This man reports that in all his years as an apostle of friendliness at Society meetings, "never once have I encountered any visible or audible objection; on the contrary, I have made many friends."

Those who have occasion to make recommendations for employment or advancement know very well that their first recommendation is generally for the man who has made the effort to be agreeable—perhaps entirely apart from his engineering ability. Some years ago the U.S. Department of Labor issued a report, dealing with the agencies through which a large group of engineers had secured jobs. The replies were astounding—about 60% of the successes had come through personal contacts; only a very small percentage reached their positions by organizational efforts.

A man's finest possessions are his friends, and he makes them usually by effort rather than by accident. Any Society meeting is a good place to put this principle into practice.

Questions on Engineering Economics

THE EXECUTIVE Committee of the Engineering Economics Division is of the opinion that among the members of the Division will be found some who can offer very good solutions for current problems involving the principles of engineering economics.

In an effort to draw these out, as well as give an opportunity for members of the Society to express themselves on current economics problems, it has been decided to suggest a question on economics in CIVIL ENGINEERING each month, to which answers are solicited from the members of the Society.

Communications on these questions should not exceed 250 words. This will at times restrict a full discussion of the question and the writer may have to limit himself to some one phase of the problem. Replies must be received by the Secretary of the Division by the 25th of the month in which the question appears. From those received, extracts may be printed in the second issue of CIVIL ENGINEERING following. While an effort will be made to select the most informative answers, time and limited clerical force will often make this impossible. Address all replies to:

Engineering Economics Division
J. H. Porter, Secretary
1204 Landreth Building
St. Louis, Missouri

It is hoped that all members of the Engineering Economics Division as well as other members of the Society will avail themselves of this opportunity to assist in the work of the Division.

The first subject for discussion is:

Define the term "engineering economics."

John Fritz Medal Awarded to E. L. DeGolyer

THE John Fritz Medal, often referred to as the highest award of the engineering profession, is devoted to the recognition of distinguished contributions in the field of applied science. This year the award goes to Everette Lee DeGolyer, consulting petroleum engineer, of Dallas, Tex., "for his vision and leadership in developing and applying the art of geophysical exploration for petroleum deposits."

A native of Kansas, Mr. DeGolyer graduated from the University of Oklahoma in 1911. After a few years with the U.S. Geological Survey, he entered the petroleum industry. He was the first engineer to recognize the importance of geophysical methods of prospecting for oil, and through these methods vast areas have been explored that were not susceptible to successful exploration by the study of surface geology. In fact, it is estimated that the discovery of 3,000,000,000 barrels of oil, in the United States alone, can be attributed to this technique. Mr. DeGolyer organized and was, for many years, chairman of the Board of the Amerada Corporation, and is now a member of the consulting firm, DeGolyer, McNaughton and McGhee, of Dallas. In 1940 he was awarded the Anthony F. Lucas Gold Medal of the American Institute of Mining and Metallurgical Engineers, of which he is member and past-president.

The Board of Award consists of four past-presidents of each of the Four Founder Societies. Previous recipients of the Medal include Thomas A. Edison, George W. Goethals, Orville Wright, Guglielmo Marconi, and Herbert Hoover.

Life Memberships Awarded to 175

On January 1, 1942, more members of the Society became exempt from dues and joined the ranks of the Life Members. This is in accordance with the constitutional provision applying to those who are 70 years of age and have paid dues as Corporate Members for 25 years and to those less than 70 who have paid dues for 35 years.

In 1938, the Society started the policy of recognizing this long period of service by the award of a life membership certificate, which carries with it the remission of all further payments of dues.

Many of the Local Sections have adopted the custom of presenting these certificates with a special ceremony at a Local Section meeting. Where no such programs are planned, the certificates are mailed direct from Society Headquarters. A total of 175 members who have received the distinction effective January 1, 1942, are listed in the accompanying table.

Many interesting letters have been received at Headquarters from members who have been apprised of their life membership status. They express deep appreciation of this honor, in such words as the following:

"This is of course quite an event in my life."

"I shall value and preserve this [certificate of life membership], I trust, for years to come, together with the privileges which it ensures."

"I have always considered it a privilege and an honor to be a member of the Society, and I am happy to know that this privilege is to continue for the rest of my life."

Many, also, take this opportunity to say what the Society has meant to them. For instance, one engineer, rounding out 35 years of membership, writes: "I have, on several occasions, found my membership to be a valuable professional asset, in addition to the opportunities it has afforded for contact with other members and for keeping in touch with current engineering practice through the publications of the Society."

Another, with the same period of membership, says: "As a young man I was inspired and benefited by the ideals of the Society and its members with whom I came in contact. Throughout my 35 years of membership I have tried to uphold the ideals of the Society and will continue to do so."

Still another writes: "I deeply appreciate the many benefits, advantages and friendships which have grown out of my years of membership. I know of no other association within the profession which has meant so much to me."

Members Exempt January 1, 1942

Altstaetter, Frederick William
Atwood, Edward Franklin
Atwood, Thomas Clark
Atwood William Greene
Bakenhus, Reuben Edwin
Baker, Percival Stevens
Barclay, Alexander James
Bass, Frederic
Bebb, Edward Crosby
Beekman, John Van Derveer, Jr.
Benfield, Abel Morris
Bissell, Clinton Spencer
Blaauw, Geert
Bowditch, John Henry
Bower, Charles Philip
Brewster, Henry Baum
Brodie, Orrin Lawrence
Brownell, Leonard Dempster
Carpenter, Clarence Edson
Carver, Thomas Henry
Chase, William Henry
Chipman, Paul
Clapp, Frank Lemuel
Clark, Thomas Stevens
Clarke, William Dexter
Cohen, Charles
Constance, Edward Cartwright
Conway, George Robert Graham
Cowles, Luzerne Simeon
Crecelius, Samuel Forder
Crosby, Walter Wilson
Cunningham, Edward Walter
Darrow, Frank Tenney
Darwin, Walton Pruett
Davis, George Jacob, Jr.
Dennis, Harry Whiting
Dent, Elliott Johnstone
Devlin, Henry Stratford
Dieck, Robert George
Dieden, Gotthard Vincent
Drane, Brent Skinner
Dunnells, Clifford George
Ellis, Charles Alton
Everham, Arthur Cassidy
Evers, William Henry
Farnham, Arthur Benjamin
Finnell, Woolsey
Fisher, Chester Centennial
Fitterer, John Conrad
Fowler, Frank George
Frickstad, Walter Nettleton
Frisell, Eric Hjalmar
Fucik, Edward James
Gandolfo, Joseph Harrington
Garlow, Ezra Clark
Garrett, James Madison
Godfrey, Edward
Green, Frederick William
Gregory, Alfred Cookman
Gregory, William Benjamin
Griswold, Harry Todd
Guise, Philip
Gundersen, August
Gustin, R. Prosper
Hadsall, Harry Hugh
Harris, Borden Baker
Harris, Guy Walter
Hartman, August Frederick
Hellyer, Henry Amyatt Chaundy
Higgins, James Wallace
Hiles, Elmer Kirkpatrick
Hill, Ernest Rowland
Hilton, Joseph Churchill
Hopkins, Newton Fisher
Hortenstine, Henry Roberts
Horton, Albert Howard
Hoyt, Henry Perez
Hulse, Shirley Clark
Hunt, Leigh Anson
Jackson, Joseph Frederick
Jahncke, Ernest Lee
Johnson, George Rufus
Johnston, James Houstoun
Johnston, John Albert
Kafka, Frederick Perceval
Kauffmann, Charles Emil
Kendall, Charles Hanford
Ketchum, Richard Bird
Killam, Charles Wilson
Knight, Earle Kelly
Lambie, Charles Sumner
Lancashire, Forest Henry
Lathrop, Jay Cowden
Layfield, Elwood Norman
Leonard, Clifford Milton
Loewenstein, Jacob
Lundberg, John Hervid
McConnell, John Lorenzo
Mansfield, Royal John
Martin, Edgar Darwin
Maurice, George Holbrooke
Means, Thomas Herbert
Metzger, Louis Charles Frederick
Middleton, Robert James
More, Charles Church
Morris, Clyde Tucker
Morse, Howard Scott
Morssen, Charles Michael
Motley, Phillips Bathurst
Mowlds, Eugene
Murray, Ray
Noerr, Robert Collyer
Oakes, John Calvin
Ott, Samuel Jacob
Palmer, George Bruce
Palmer, Shepard Brown
Pease, Frederick Atwood
Perrine, George
Perring, Henry Garfield
Philips, James Harry
Phillips, John Carleton
Pistor, George Emil John
Pohl, Charles Andrew
Porter, Sam Graham
Pratt, Wallace Williams
Quimby, Charles Henry, Jr.
Rands, Harold Alva
Ray, Frank Oliver
Reichardt, Walter Frederick
Rhodes, Harry Willet
Richmond, Julian (Pierre William)
Robbins, Franklin Henry
Rowland, Walter
Rugg, Warren Fuller
Savage, John Lucian
Schoder, Ernest William
Schwarze, Carl Theodore
Seery, Francis Joseph
Shand, James
Shaw, David Joseph
Shuman, Edward Peter
Simpson, Paul Dyer
Smetters, Samuel Tupper
Smith, Albert
Solomon, Gabriel Roberts
Spiker, William Claer
Stearns, Ralph Hamilton
Stepath, Charles Underhill
Stern, Isaac Farber
Stiles, Arthur Alvord
Stubblefield, Garfield
Suter, Russell
Temple, Edward Brinton
Thanheiser, Charles August
Thurston, Eugene True
Tudor, Clinton Gambrill
Tyler, Roy Dexter
Underwood, Howard Warren
von Phul, William
Von Schrenk, Hermann
Wardle, Edward Beaumont
Waugh, William Hammond
Weeks, William Charles
Weidel, Joseph
Whitman, Ralph
Whitney, Thomas Bryan
Wildes, Waldo Gilman
Willoughby, Julius Edgar
Wise, Albert Joseph
Wood, Dethic Hewitt
Woodcock, Henry Wright
Worley, John Stephen
Wright, John Bertram
Yates, Eugene Adams
Zabriskie, Albert Menger

Standards for Letter Symbols—Mechanics and Hydraulics

TWO PROPOSED standards, under the general designation of Letter Symbols and Abbreviations for Science and Engineering are approaching completion; they are titled "Letter Symbols for Mechanics of Solid Bodies" and "Letter Symbols for Hydraulics." The form for these two standards was approved by the Society Board of Direction at its Chicago meeting, October 13. In fact, these standards have passed through all the technical channels, with agreement as to present wording. They are now before the American Standards Association for formal approval and designation as American Standards.

The study of symbols for mechanics of solid bodies goes back to an investigation started in 1914 by the Society for the Promotion of Engineering Education. Activity under the American Standards Association began in 1926. After reorganization in 1936, the work has progressed steadily through all the ramifications of exchange of recommendations and approval until it is now in what appears to be the final form, revisions having been issued in 1938 and 1940. The Society's representative in this work if Prof. Albert Haertlein of Harvard University.

Similarly, the work on symbols for hydraulics has an extended history. A committee of the Society began working in 1926 and brought out its first report in 1931, approved by the special Committee on Irrigation Hydraulics. Following publication in PROCEEDINGS and discussion, a final report on "Letter Symbols and Glossary for Hydraulics," with special reference to irrigation, was published as Manual No. 11 in 1935.

Work under the American Standards Association also began in 1926. This was reorganized in 1936. The two activities were merged under J. C. Stevens, M. Am. Soc. C.E., who had served as secretary of the Society's committee and now became the representative of the Society on the joint committee. A list of general symbols was published in November 1939 in CIVIL ENGINEERING. Through subsequent discussion and revision, the present final draft has been developed as here given.

Each standard is accompanied by an identical statement of "General Principles of Letter Symbol Standardization," in the form here given. These standards are being presented so that they may be available for immediate use by members. If the standards are formally approved by the American Standards Association, as expected, they should then enjoy general acceptance. They have the endorsement of five sponsor organizations who have cooperated in bringing them into being:

American Society of Civil Engineers
American Society of Mechanical Engineers
American Institute of Electrical Engineers
Society for the Promotion of Engineering Education
American Association for the Advancement of Science

General Principles of Letter Symbol Standardization

1. Manuscript. In preparing manuscripts, it is suggested that authors give careful attention to the use of symbols from this and other standard lists and to the principles here given. Symbols used should be defined clearly. When a table of symbols is not given, it is desirable to make reference to the standard lists from which the symbols are taken. The many numbers, letters, and signs which are similar in appearance should be distinguished carefully.

2. Letter Symbol. A letter symbol is a single character, with subscript or superscript if required, used to designate a physical magnitude in mathematical equations and expressions. Two or more symbols together always represent a product.

Letter symbols are to be distinguished from abbreviations, mathematical signs and operators, graphical symbols and chemical symbols:

- (*a*) *Abbreviations* are shortened forms of names and expressions employed in texts and tabulations and should not be used as symbols in equations.
- (*b*) *Mathematical signs and operators* are characters used with letter symbols to denote mathematical operations and relations.
- (*c*) *Graphical symbols* are conventionalized diagrams and letters used on plans and drawings.
- (*d*) *Chemical symbols* are letters and other characters designating chemical elements and groups.

3. The same symbol should be used for the *same physical magnitude* regardless of the units employed and regardless of special values occurring for different states, points, parts, times, etc. Units or special values may be distinguished when necessary by subscripts, superscripts, or by upper and lower case letters when both are specifically included as symbols in a standard list. The units used should be indicated when necessary. Sometimes different symbols are used for the components of a vector.

4. Subscript. A subscript preferably should be a simple character. It is commonly employed to indicate constancy of a particular physical magnitude, such as pressure or temperature, when there are other variables. A multiple subscript, sometimes divided by a comma, refers to more than one state, point, part, time, etc. A subscript should not be attached to a subscript. Further uses of subscripts are listed in Principles 3 and 6.

5. Superscript. A symbol with a superscript, such as a prime (′) or a second (″), should be enclosed in parentheses, braces, or brackets before affixing an exponent. A complicated exponent (or any other expression frequently repeated) may be replaced by a single symbol selected to represent it. Reference marks should not be attached to symbols. Further uses of superscripts are listed in Principles 3 and 6.

6. Conflicts. Conflicts which would occur when different physical magnitudes are assigned the identical symbol in the same or different standard symbol lists may be resolved in one of the following ways:

- (*a*) For one or more of the conflicting uses, the given symbol may be employed with subscript or superscript selected by the author.
- (*b*) If one of the magnitudes has an alternate symbol in a standard list, it may be used.
- (*c*) A slight change in the name of the magnitude may remove the conflict. For instance, one may use L for "length of radius" when r for "radius" conflicts with r used for another magnitude.

7. Unlisted Magnitudes. To symbolize a special value of a listed magnitude, see Principle 3. The symbol chosen by an author for a physical magnitude not appearing in any standard list should be one that does not have already a different meaning in the field of the text.

8. Typography. Letter symbols, letter subscripts, and letter superscripts, whether upper or lower case, should be printed with italic type unless definitely specified otherwise. On manuscript this is indicated by underlining each symbol which is to be italicized. Special types, such as Old English and type that is currently used for vector magnitudes, should be avoided for scalar magnitudes. When special type is used for vector magnitudes, the same italic letter should be used for the corresponding scalar magnitude. Vertical Arabic numerals should be used as coefficients in equations and in subscripts and exponents. Bars, dots, and other modifying signs and operators should be used in the manner currently recognized by mathematicians.

Letter Symbols for Concepts in Mechanics of Solid Bodies

α	acceleration, angular
g	acceleration, gravitational
a	acceleration, linear
A	[1]amplitude
α, β, γ..	angles
ω	angular velocity
A	area
b	breadth (width)
ω	circular frequency ($2\pi f$)
μ, f	[2]coefficient of friction
α	coefficient of expansion, linear
c	damping coefficient, velocity
δ	[3]deflection of beam, maximum
h	depth (same as height)
ρ	density, mass per unit volume $= \frac{\gamma}{g}$
D, d	diameters
s	distance, arc length
e	eccentricity of application of load
η	efficiency
δ	elongation, total

E_k, T	[4]energy, kinetic
E_p, V	[4]energy, potential
N	factor of safety
P, Q, F	[5]forces or loads, concentrated
f	frequency
k	gyration, radius of
h	height, depth, or thickness
I	inertia, moment of (mass)
J	inertia, polar moment of (area)
I_{xy}	inertia, product moment of
I	inertia, rectangular moment of (area)
l, L	lengths
w, q	load per unit distance
W, P	load, total
m	mass
E	modulus of elasticity (Young's modulus)
G	modulus of elasticity in shear
Q	moment of area (statical or first moment)
M	moment of force, including bending moment
c	neutral axis, distance to extreme fiber from
n, N	number
T	period
ϕ	phase angle
μ	Poisson's ratio

P	power
p	pressure, normal force per unit area
r, R	radii
n	revolutions per unit time
Z	section modulus
V	shearing force in beam section
k	spring constant (load per unit deflection)
ϵ	strain, normal
γ	strain, shear
σ s	stress, normal
τ, s_s	stress, shear
K	stress concentration factor
T	temperature, absolute
t, ϑ	[6]temperature, ordinary
h	thickness (same as height)
t	time
T, M	torque
v	velocity, linear
V	volume
λ	wave length
W	weight
γ	weight per unit volume
b	width (same as breadth)
W, W_k	[7]work

Subscript usage not included in table. For example, the symbol for stress may be used in the following manner: $\sigma_x, \sigma_y, \sigma_z$ for directional notation; σ_o, σ_v for steady and variable stress, respectively; σ_u for ultimate strength; σ_e for endurance limit, etc.

[1] Also subscript notation, such as x_0, y_0.

[2] Use f for coefficient of friction where Poisson's ratio or absolute viscosity is also involved.

[3] Also subscript notation, such as y_m.

[4] Use T and V for elasticity problems (avoids confusion with Young's modulus).

[5] Use F for force in mechanical engineering problems (P for power).

[6] Use ϑ for temperature in cases where both time and temperature are involved.

[7] Use W_k for work where weight is also involved.

Letter Symbols for Hydraulics

The following are offered as preferred symbols, no alternates being indicated. Nevertheless authors are expected to use alternate symbols where confusion would otherwise result. Examples: τ may be used for time instead of t, to avoid confusion with temperature or thickness; V_L may be used for volume or W_k for work to avoid confusion with velocity and weight. Appropriate subscripts may be used with any symbol given. Examples: y_1, y_2; h_{f1}, h_{f2}; $C_{e1} \frac{V_1^2}{2g}$

GENERAL SYMBOLS

α	acceleration, angular
g	acceleration, gravitational
a	acceleration, linear
	altitude (see elevation)
A	area, total cross-sectional
	breadth (see width)
$\mathbf{C}$	Cauchy number
C	coefficient, general
C_c	coefficient of contraction
C_q	coefficient of discharge
C_e	coefficient of energy per unit weight in $C_e \frac{V^2}{2g}$
C	coefficient of flow (Chezy)
f	coefficient of friction (Weisbach-Darcy)
C_m	coefficient of momentum per unit weight in $C_m \frac{V}{g}$
m	coefficient of roughness (Bazin)
n	coefficient of roughness (Kutter and Manning)
C_v	coefficient of velocity
ρ	density, mass per unit volume $= \frac{\gamma}{g}$
y	depth, perpendicular to stream bed
y_c	depth, Belanger critical
y_0	depth for uniform flow
y'	depth, vertical
D	diameter
q	discharge (rate of flow), per unit width
G	discharge (rate of flow), total sediment
Q	discharge (rate of flow), total water
η	efficiency
K	elasticity (bulk modulus of liquids)

e	elasticity, kinematic $\frac{K}{\rho}$
Z	elevation, above datum
Z_0	elevation, above stream bed
E	energy
	energy, per unit time (see power)
	energy, per unit weight (see head)
	flow (see discharge)
F	force, total
	friction factor (see coefficient)
$\mathbf{F}$	Froude number
h_a	head, atmospheric
h_i	head, lost in eddies
h_f	head, lost by friction
h_{ps}	head, potential (piezometric)
h_p	head, pressure
H_0	head, specific (above stream bed)
H	head, total
h_v	head, velocity
R_m	hydraulic radius, mean in a reach
R	hydraulic radius, of cross-sectional area
L	length, along stream bed
x	length, horizontal
m	mass
	mass per unit volume (see density)
N	number, in general
P_m	perimeter, mean in a reach
P	perimeter, wetted of sectional area
P	power (energy per unit time)
p_a	pressure, intensity of, atmospheric
p	pressure per unit area (intensity of)

r	radius, general (see also hydraulic radius)
R	Reynolds number
	roughness (see coefficient)
s	slope, of cuts and embankments (1 vert on s horiz)
S_0	slope, of channel bed
S	slope, of energy grade line (friction slope)
S_u	slope, of hydraulic grade line
γ	specific weight (force per unit volume)
σ	surface tension
ω	surface tension, kinematic $\frac{\sigma}{\rho}$
t	temperature, thermometric
T	temperature absolute
t	thickness
t	time
ω	velocity, angular
V_c	velocity, Belanger critical
u, v, w	velocity, components in x, y, z directions, respectively
V	velocity, mean (Q/A)
V_0	velocity, of uniform flow
c	velocity, of wave, celerity
$\bar{u}, \bar{v}, \bar{w}$	velocity, temporal means of components
μ	viscosity, dynamic (absolute)
ν	viscosity, kinematic $\frac{\mu}{\rho}$
V	volume
	weight, per unit volume (see specific weight)
W	weight, total
b	width, of stream bed
b_w	width, of water surface
z	weirs, crest height
b	weirs, crest length
N	weirs, degree of submergence
W	work
W	Weber number

SPECIAL SYMBOLS FOR HYDRAULIC STRUCTURES

In addition to the General Symbols use the following symbols for special magnitudes:

ϕ	angle between center radius of crown of arch and any other radius
α_0	angle between principal stress and horizontal
ϕ_1	angle, half the central angle of the arch
α	angle of expansion (or contraction) of conduit
D_i	diameter, inside
D_0	diameter, outside
Q'	discharge used in design
μ	Poisson ratio
p	porosity, per cent of voids
F_a	pressure, atmospheric, total force of
F_h	pressure, horizontal component of resultant
F_n	pressure, normal component of resultant
F_r	pressure, resultant of total
F_u	pressure, resultant uplift
F_v	pressure, vertical component of resultant
F_s	shearing force, total
τ	shearing stress (intensity)
τ_x	shearing stress, parallel to horizontal plane
τ_y	shearing stress, parallel to vertical plane
σ_1	stress, first principal
σ_y	stress, horizontal, normal to a vertical plane
σ	stress (intensity)
σ_2	stress, second principal
σ_x	stress, vertical or horizontal plane (trapezoidal law)

SPECIAL SYMBOLS FOR HYDRAULIC MACHINERY

In addition to the standard symbols use the following symbols for special magnitudes:

δ	angles, any small displacement
α	angles, between tangent to runner and absolute velocity of water
β	angles, between tangent to runner and relative velocity of water
K_c	capacity factor
C_d	coefficient, of drag
D	diameter, runner or impeller
D_1	diameter, runner or impeller at mid entrance space
D_2	diameter, runner or impeller at throat
W	discharge, actual weight of
W_t	discharge, theoretical weight of
η_h	efficiency hydraulic, based on head
η_m	efficiency, mechanical including losses
η_g	efficiency of motor or generator
η_p	efficiency of pump
η_t	efficiency of turbine
η_v	efficiency, volumetric, including leakage
B_0	gate opening factor, initial
h_t	head, on turbine in case entrance or on impulse wheel at base of nozzle
h_s	head, pressure for surge
h_0	head, pressure for steady flow
h_{sv}	head, total dynamic above vapor pressure at eye of pump
H_0	head, pressure rise above normal
H_z	head, pressure rise for instantaneous closure
K_l	load factor
K	pipe line constant
P_b	power, brake hp
K_p	power factor
P_h	power, hydraulic hp
P_1	power, of turbine under 1 ft head
P_w	power, water hp
p_a	pressure, intensity of atmospheric, corrected for barometric
p_g	pressure, intensity of, gage
p_v	pressure, intensity of, vapor
r	radius, to any point on runner or impeller
n	speed, rpm
n_e	speed, rpm, for maximum efficiency
ϕ	speed, rpm, ratio of peripheral to velocity head
n_r	speed, rpm, runaway
n_s	speed, rpm, specific
n_1	speed, rpm, under 1 ft head
F_t	thrust, hydraulic
t_a	time, gate travel
t_g	time, governor
V_a	velocity, absolute at any point
h_a	velocity head of approach velocity
V_0	velocity, in conduit near gate, for steady flow
V_m	velocity, meridional component, absolute
u	velocity, of point of runner
V_r	velocity, radial component, absolute
v	velocity, relative, water to runner
V_u	velocity, tangential component, absolute
f	wave, height of after reflection
c	wave, celerity of gravity wave
b	width of runner entrance
W	weight of rotating part

SPECIAL SYMBOLS FOR HYDRAULIC MODELS

Use standard symbols for all magnitudes in both model and prototype. Where necessary to distinguish between them, use the following subscripts either to a single symbol or to an entire equation:

For magnitudes in model	m
For magnitudes in prototype	p
For ratio model to prototype	r

EXAMPLES:

(1) Length in model L_m

Length in prototype L_p

Scale, model to prototype $\frac{L_m}{L_p} = L_r$

(2) $\frac{Q_m}{Q_p} = Q_r = \left(\frac{L_m}{L_p}\right)^{5/2} = L_r^{5/2}$

(3) $$\frac{V_m}{V_p} = \frac{C_m \sqrt{R_m S_m}}{C_p \sqrt{R_p S_p}} = \frac{(C\sqrt{RS})_m}{(C\sqrt{RS})_p} = (C\sqrt{RS})_r$$

(4) Energy equation for flow in a pipe,

$$\left[Z_{c1} + \frac{p_1}{\gamma} + \frac{V_1^2}{2g} = Z_{c2} + \frac{p_2}{\gamma} + \frac{V_2^2}{2g} + h_f\right]_{m,\text{ or } p,\text{ or } r}$$

according as equation is for model, prototype, or their ratio. Z_c in above signifies elevation of center line of pipe.

Construction Engineering Prize to E. L. Durkee

As announced in the December issue of Civil Engineering, the Construction Engineering Prize for 1941 has been awarded to E. L. Durkee, M. Am. Soc. C.E., for his paper on "Erection Methods on Baton Rouge Bridge," published in the March number of Civil Engineering.

E. L. Durkee

This is the third award of the Construction Engineering Prize, the first having been made in 1939. Following the customary procedure, presentation of the prize will take place at the Society's Annual Meeting in January. The prize was established in 1939 through the generosity of A. P. Greensfelder, M. Am. Soc. C.E., and is to be given annually for the best original scientific or educational paper on construction published in Civil Engineering. It is the only prize specifically limited to material appearing in that publication. The award is made on recommendation of the Executive Committee of the Construction Division, followed by approval of the Board of Direction.

A graduate of Worcester Polytechnic Institute in 1919, Mr. Durkee has spent his entire professional career with the McClintic-Marshall Company and, since 1931, the Bethlehem Steel Company. From 1920 to 1923 he was with the company's construction force in India, engaged on iron plant and steel mill construction. He then returned to the engineering department at Pittsburgh, Pa., where he remained for three years before being assigned as resident engineer on the erection of the Outerbridge Crossing between Perth Amboy, N.J., and Tottenville, Staten Island. Later (1928 to 1929) he was resident engineer on the erection of the Cooper River Bridge at Charleston, S.C. In 1930 he returned to the engineering department in charge of the bridge squad that in 1938 made all the joint layouts and other details of design on the Baton Rouge Bridge over the Mississippi, and in February 1939 went to Baton Rouge to serve as resident engineer on the construction of this project. More recently Mr. Durkee served as resident engineer on the erection of the new Rainbow Bridge at Niagara Falls, N.Y., which was opened to traffic on November 1, 1941.

Radio Program of Founder Societies

A series of radio broadcasts, dealing with five branches of engineering—civil, mechanical, electrical, mining, and chemical—has been instituted by the four Founder Societies and the American Institute of Chemical Engineers. It is planned that these broadcasts will go on the air about the first of February and last for thirteen weeks, with one program each week.

The American Society of Civil Engineers will sponsor three of the programs and will be responsible for all details in connection with them. In addition it may participate in a joint program which is now being projected for the end of the series. The Society committee that has been appointed for this work consists of Waldo G. Bowman, E. L. MacDonald, and Harold Wessman.

Engineer Registration in New York State

Extracts from First Progress Report of Committee on Professional Relations of Metropolitan Section

Dated November 19, 1941

The Licensing Law has now been in effect in New York State for 20 years. Written examinations were not given until 1931. For the 10-year period from 1921 through 1930 (calendar) over 17,000 applications for license as professional engineer or land surveyor, or both, were reviewed by the Board of Examiners. These included new applications and old applications which during the period may have been reconsidered one or more times. About 90% of the certificates of license applied for during this period were granted, all without written examinations and based solely on meeting the then required experience qualifications.

During the 7-year period from 1931 through 1937 (calendar) substantially the same type of written examinations were in effect. During this period the Board reviewed nearly 20,000 applications, of which about 11,000 were new applications and the remainder were cases reconsidered one or more times. About 8,000 certificates of license were granted. Of these about 5,000 were granted on experience alone and about 3,000 as a result of passing written examinations.

Since 1938 the present type of written examinations has been used. During the 3-year period from 1938 through 1940 (calendar) the Board has reviewed about 5,000 applications, of which over 1,300 were new applications and the remainder were old cases reconsidered one or more times. About 1,500 certificates of license were granted. Of these nearly 1,000 were issued as the result of passing written examinations and only about 500 on experience alone. It will be noted that during this 1938–1940 period about 63% of the certificates issued were as a result of passing written examinations, while in the preceding period (1931–1937) the corresponding percentage was only 38%. Written examinations were started in 1931 and about 42% of all certificates of license issued since that time were as the result of passing written examinations. This percentage is year by year increasing.

It has always been the policy of the Board to reconsider an application on request of the applicant. In some cases over a period of years the application of the same person has been reviewed as many as ten times. So far as the work of the Board is concerned, it requires about the same amount of effort to review and pass on an old application as it does to consider a new application. The records show that from 1921 through 1940 (calendar) the Board has considered about 42,000 applications, of which approximately 24,000 were new cases and 18,000 reconsidered cases. The number of licensed engineers registered and legally entitled to practice in New York State in 1941 was 14,742.

During the past year, the enforcement officials of the State Education Department handled 102 cases of alleged violation of the Engineers' Law, classified as follows: Illegal practice where registration was never obtained, 41; illegal use of title "Engineer" or "Engineering," 45; improper practice by registrants, 13; unclassified, 3. The procedure on these complaints was: Letter of notification to alleged violator, 37; formal hearing conducted by the Board of Examiners, 1; filing of formal charges, 2. The action taken on these cases was as follows: Agreement secured to discontinue practice, 35; complaint unfounded or not fully sustained, 51; cases pending, 16.

It is the policy of the enforcement authorities to use conference and persuasion in preference to summary court action. A typical recent case is that of an unqualified individual who sought to convey the impression that he was a civil engineer by writing the initials "C.E." after his name on business letters. He explained the abbreviation as standing for "Chief Engineer" of the metal fabricating company which he owned. The Investigator for the Professions secured the promise of this individual to discontinue appending to his name the designation "C.E."

The personnel of the New York State Board as of June 30, 1941, is as follows: Norman R. Gibson, M. Am. Soc. C.E., chairman; David B. Steinman, M. Am. Soc. C.E., vice-chairman; Roy G. Finch, M. Am. Soc. C.E., secretary; Erich Hausmann; Virgil M. Palmer.

This information has been taken from the progress report submitted to the Metropolitan Section by D. B. Steinman, chairman of the Section's Committee on Professional Relations.

National Roster of Specialized Personnel

By STEWART HENDERSON BRITT

CONSULTANT, NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL, WASHINGTON, D.C.

A MOST important phase of the defense program is being conducted by the National Roster of Scientific and Specialized Personnel, a joint project of the National Resources Planning Board and of the U.S. Civil Service Commission. The object of this roster, in which the Society has aided materially, is to make available in one central office an index of all American citizens who have special scientific or professional skills that may be of importance to the nation in periods of emergency and in normal times. England has completed a somewhat similar register under the sponsorship of the Royal Society of London.

The National Roster has been developed as a means of recording in an accurate way one of the important human resources of the nation. The fundamental idea is conservation. While many specialists will be needed by the Government in a program of national defense, it is also recognized that the conservation of specialized work now being performed in private industry is of equal importance to the nation. It is most desirable not to disturb an important cooperating group of scientists in a certain laboratory if similarly trained experts not so engaged can be found elsewhere.

Cooperating with the Roster and the joint administrative agencies in addition to the Society, are the National Research Council, the Social Science Research Council, the American Council on Education, and the American Council of Learned Societies. These groups and their component societies serve the Roster in a scientific and technical consultative capacity. They have rendered much assistance in connection with the preparation of the technical check lists for the various fields of scientific specialization for each profession. Secretary Seabury of the Society is a consultant to the National Roster.

Information for the Roster is compiled through the circularization of each scientific and professional field by means of a general questionnaire and technical check list pertaining to the particular field being surveyed.

The Roster has to date conducted its surveys in 48 fields of scientific and professional endeavor and has listed in its various registers the qualifications of approximately 200,000 persons. When complete, the Roster will cover more than 75 sciences and professions, and it is believed by federal authorities that it will far surpass like indices set up by other nations and will continue to prove invaluable not only in the present emergency but in normal times as well.

A brief outline of what has been accomplished by the Roster in the field of civil engineering through the cooperation of the Society might be of particular interest. To date 19,064 questionnaires have been mailed and 10,488 replies have been received. It is urged that those who have not as yet returned questionnaires do so as soon as possible. A number of those who have replied have been contacted by the various defense agencies relative to services which they could render the Government. Some have accepted and others, because of various circumstances, have had to decline.

The lists are at present being used to locate individuals with special skills in many different fields who will voluntarily place their abilities at the Government's service in well-paid positions, and in some cases in positions generally described as "dollar-a-year" jobs.

Before an individual with a special skill is offered an opportunity to serve his country, his present employment is studied and if it is deemed of importance to the nation as a whole, he is not offered the new position. This is because the Roster also serves as a conservation agency. However, if an individual is offered a position, it is left to his own discretion whether or not he wishes to accept it, and no pressure of any sort is brought to bear on him.

The filing of a questionnaire with the National Roster is not considered as an application for a position and should not be regarded as such by anyone.

At present the National Roster of Scientific and Specialized Personnel is engaged in a collection of special information about persons registered with it whose age would make them subject to call for training and service under the provisions of the Selective Training and Service Act of 1940. Although the Roster has no direct authority with reference to classification or induction procedures under the Selective Service System, it is charged with the obligation of assisting the nation in using the trained personnel in the most effective way possible. Accordingly, under a cooperative plan, the Roster in certain cases will transmit to the office of the National Headquarters of the Selective Service System in Washington, D.C., appropriate information about technically trained persons of military age, and that office in turn may send letters about these men to their Local Boards, to assist in the determination of their proper classification. Of course, it should be understood that the matter of classification and induction is within the jurisdiction of the Selective Service Local Boards.

Also, whenever a man registered with the National Roster is likely to be inducted into the Army, information is sent to the appropriate division of the War Department, on his educational training, occupational experience, and other pertinent data. Obviously, no guarantee can be given in advance that this procedure will result in any special privilege, since there are occupational shortage problems within the Army as well as personality factors that must be taken into account. But the information we have been sending to the War Department about various men has been of very practical use in the procedure of assigning such technically trained individuals to their duties.

As previously stated, the lists of the National Roster are fundamentally records of the scientific and professional men of the nation, and as such they are being used to their fullest extent to conserve the human resources of America.

Appointments of Society Representatives

THOMAS R. AGG, M. Am. Soc. C.E., has been appointed to succeed **JAMES K. FINCH**, M. Am. Soc. C.E., as Society representative on and chairman of the Alfred Noble Joint Prize Committee for the five-year term beginning January 1, 1942.

WALDO G. BOWMAN, Assoc. M. Am. Soc. C.E., chairman, and **EUGENE L. MACDONALD** and **HAROLD WESSMAN**, Members Am. Soc. C.E., have been appointed to represent the Society in a collaboration of the Founder Societies in a series of radio talks on engineering subjects.

DAVID L. ERICKSON, M. Am. Soc. C.E., has been appointed to take the place of incoming President E. B. **BLACK** on the Executive Committee of the Engineering Economics Division in accordance with the custom of relieving incoming members of the Board of committee appointments.

RAYMOND F. GOUDEY, M. Am. Soc. C.E., has been appointed to take the place of incoming Director A. M. **RAWN** on the Executive Committee of the Sanitary Engineering Division.

ALONZO J. HAMMOND, Past-President Am. Soc. C.E., has been appointed the Society's representative on the Engineers' Committee of the Contract Distribution Division of the Office of Production Management.

GEORGE L. LUCAS, M. Am. Soc. C.E., was appointed to represent the Society at the annual banquet of the National Council of State Boards of Engineering Examiners, which was held in New York City on October 28, 1941.

Bermuda Trip Abandoned

PREVIOUSLY announced plans for an inspection trip to Bermuda to visit Army and Navy construction work there, following the Annual Meeting of the Society in January, have had to be given up. Too late for noting in the December number, passport restrictions were extended to include Bermuda. Now the declaration of war by the Axis Powers has canceled all lingering hope of arranging a satisfactory or comfortable trip.

Army and Navy officials had offered cooperation to the fullest extent, so it is with real regret that the Meeting Committee announces the abandonment of this inspection trip to Bermuda.

Progress Report of Joint Committee on Seismology

By R. V. Labarre, *Chairman*

The appointment of the Joint Committee on Seismology is a responsibility of the Soil Mechanics and Foundations Division—but with the necessary help and cooperation of the other Technical Divisions. The committee has an interesting background.

Damaging earthquakes have occurred from time to time for untold centuries. Out of the disastrous earthquake of 1880 in Japan grew the Japanese Seismological Society, and out of the San Francisco earthquake of 1906 sprang the Seismological Society of America. Records of earthquakes have also been kept in European countries. Some of these disastrous events have been studied by engineers but the net result has been that, except for some empirical formulas, there is nothing tangible and authentic upon which the engineer can base proper assumptions for the design of structures. Reports of engineering commissions have been rendered after certain violent earthquakes, but principally because of the exhaustive character of these reports and the lack of available funds, few have ever been published.

The U.S. Coast and Geodetic Survey, through its Division of Geomagnetism and Seismology, has been active in developing instruments and securing observations on the characteristics of earthquake motions. In 1932, this division adopted a program of observations in cooperation with a group of California engineers, which has been modified from time to time. Although important work has been done at the universities, especially at the University of California and the California Institute of Technology, no organization has been definitely charged with the function of determining just what the program should be to meet the needs of engineers, or what should be done to apply the results to actual design.

Vibration studies have been made on numerous buildings. The greater part of this material has been published in Special Publication No. 201, of the U.S. Coast and Geodetic Survey, "Earthquake Investigations in California 1934–1935," but there has been no attempt to analyze the data in any satisfactory manner.

Many of the Technical Divisions of the Society have an interest in the phenomena of earthquakes and their effect upon engineering structures, but no one had attempted to develop the subject for the engineer's use. The Soil Mechanics and Foundations Division advanced the proposition that it should take the lead in this matter because earthquake phenomena, originating in the ground, affect structures through their foundations, and because the local effect of an earthquake depends largely on the geological structure of the area, since the energy expended at any point is dependent both upon the arriving energy and upon local foundation conditions. The Joint Committee on Seismology was therefore formed under the sponsorship of the Division of Soil Mechanics and Foundations, with joint representation from such other Divisions as were interested. In a resolution presented to the Technical Procedure Committee at Kansas City, in April 1940, the duties of the Joint Committee were outlined as follows:

1. To complete a bibliography.
2. To codify and appraise what is now known on the subject, separating facts from theories.
3. To outline current practice.
4. To describe the essential data not now available and to determine directions in which further research is needed.
5. To keep close contacts with future developments in the field of seismology.
6. To act as a general clearing house of information on the subject.
7. To recommend design assumptions for the earthquake forces to be resisted.
8. To conduct and foster seismological research, experimentation, compilation of records, and study.

The following Technical Divisions have shown their interest and each has named an appointee to the Joint Committee, as follows:

Construction	David Bonner, New York
Highway	L. W. Teller, Washington, D.C.
Irrigation	Ivan E. Houk, Denver
Power	H. W. Dennis, Los Angeles
Soil Mechanics and Foundations	R. V. Labarre, Los Angeles, Chairman, and N. H. Heck, Washington, D.C.
Structural	Glenn B. Woodruff, San Francisco
Waterways	Charles T. Leeds, Los Angeles

As can be observed from the geographical distribution of the appointees, the committee is far flung, and therefore much of its work must be done by correspondence. This fact has to some extent delayed the progress of its activities. The topics and sequence of operations that have been generally determined by a canvass of opinion are somewhat as follows:

1. In order that confusion may be minimized, a standard nomenclature with definitions should be adopted. Glenn B. Woodruff has accepted the chairmanship of a subcommittee to prepare these with the assistance of the following members of the Society: Prof. H. E. Davis, of the University of California; Henry D. Dewell, consulting engineer of San Francisco; and Dr. Perry Byerly, in charge of the seismological department of the University of California.

2. A bibliography should be prepared, with a digest of articles and reports, to include not only material actually published but also reports known to have been prepared but not printed. For such reports, it is considered that a digest or analysis will serve the purpose as well as the full report. Accordingly, the preparation of such digests has been outlined as the second, and one of the most important, aims of the Joint Committee. The chairman and subcommittee for this work have not yet been selected.

3. Capt. N. H. Heck, of the Coast and Geodetic Survey, has accepted the chairmanship of the subcommittee to report on the seismological work of the U.S. Coast and Geodetic Survey. Captain Heck has submitted a very comprehensive report on the subject, which has been distributed to the members of the Joint Committee. An article based on this report appears in this issue.

Subcommittees are in process of formation to prepare comprehensive reviews on the following: (1) the practice of engineers and geophysicists in securing data on the vibration of buildings and structures, (2) the practice of testing models on shaking tables, (3) the scope of studies and tests being done by Government bureaus and at universities, and (4) current practice in design.

It is regretted that the Government's taking of competent men for defense work has decimated the ranks of available engineers, and has prevented the formation of the subcommittees as rapidly as had been expected when the Joint Committee was authorized. However, it is the hope of the Chairman that these subcommittees will be formed at an early date, and that the work planned will be well under way by the end of 1941.

Exemptions of Dues for Military Men

Since the declaration of war on December 8, several letters have been received at Society Headquarters from members who have been called to service, or who are about to enlist with the armed forces. Because of the concern expressed by these men regarding payment of their dues while in service, it has been decided to publish again the resolution adopted by the Board of Direction in October 1940:

"*Resolved:* That members of the Society training or serving the country in the armed forces of the nation during the present limited emergency will be eligible for exemptions from dues under the following conditions:

"(1) Only enlisted Selectees, by operation of the Selective Service Act, and enlisted personnel of the Regular Army, the National Guard, and the Navy, shall be eligible.

"(2) Those holding commissions shall not be eligible except as they may apply for exemption which may be granted by action of the Executive Committee of the Society.

"(3) The period of exemption shall be limited to the period of national service.

"(4) In case of change of status, as by commissioned promotion, the conditions of exemption shall be modified accordingly.

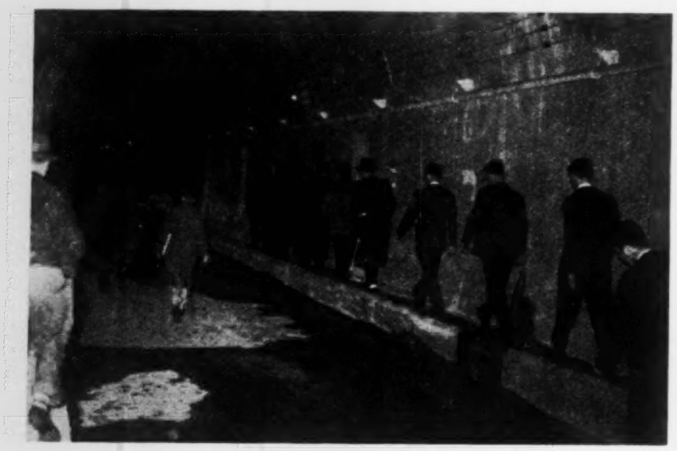
"(5) Exemption shall be granted only on application on form to be prescribed."

These conditions for exemptions are expressed in the negative but the spirit behind the phraseology is the positive desire of the Board of Direction to be helpful to those who are experiencing financial difficulties because of their service in the armed forces of the country.

The Chicago Conference of Student Chapters

DELEGATES from nineteen Student Chapters in widely separated parts of the country attended the conference held in Chicago, on October 15 and 16, in conjunction with the Fall Meeting of the Society.

The conference opened Wednesday morning with Dean L. E. Grinter, chairman of the Illinois Section Committee on the Student Chapter Conference, calling the meeting to order and welcoming the delegates. The meeting was then turned over to Clifford R. Krabbenhoft, president of the Juniors of the Illinois Section, who discussed the purpose of the Student Chapter conferences. The other speakers were Henry Townley Heald, president of the Illinois Institute of Technology; Franklyn Bliss Snyder, president of Northwestern University; J. H. Porter, chairman of the Society's Committee on Student Chapters; Col. Charles T. Leeds, chairman of the Society's Committee on Professional Conduct; Walter E. Jessup, Acting Assistant Secretary; and J. E. Jagger, new Field Secretary.



CHAPTER MEMBERS VISIT THE CHICAGO SUBWAY

The program included the election of officers for the conference, the results being as follows: John Ramirez, of Stanford University, president; Vic Greimann, of Iowa State College, vice-president; and Elwyn H. King, University of Illinois, secretary. The remainder of the morning session was devoted to the Student Technical Paper Contest, sponsored yearly by the Illinois Section. First prize ($20 in cash to cover entrance fees as a Junior in the Society and one year's dues) went to Joseph E. Love, Jr., of Northwestern University, for his paper on "Tunneling Methods in Chicago Clays"; second prize (also $20) to Lauress Wise, of Stanford University, for his paper on "The Turnover Method"; and third prize ($10 for entrance fees) to Howard Stevens, of Illinois Institute of Technology, for his paper on "Railroad Engineering Problems." Arthur Johnson, of Rose Polytechnic Institute, received honorable mention for his paper on "Waste Oil Disposal."

Wednesday evening the students attended the dinner-dance en masse and, to the apparent delight of the seniors, took over. An innovation was the highly efficient "dating bureau" of Harry Lyle, secretary of the Section's Juniors, who produced 50 charming Northwestern University "coeds" for out-of-town members desiring dates.

The presentation of student papers was completed at the Thursday morning session. The climax of the meeting, however, was the Thursday luncheon, which was attended by Past-President Mead. With the exception of Toastmaster Loran D. Gayton, the members of the Section did no after-dinner speaking, but left that to the representatives of the various Chapters who delivered entertaining one-minute speeches. After a spirited discussion regarding the possibility of making the Student Chapter Conference an annual affair, a committee was formed to plan a regional conference for next spring. The members are Charles E. Dahlgren, of the University of Minnesota; Vic Greimann, of Iowa State College; Elwyn H. King, of the University of Illinois; E. McMillan, of Northwestern University; John Newlin, of Rose Polytechnic Institute; J. A. Reisterer, of Michigan College of Mining and Technology; Howard Stevens, of Illinois Institute of Technology; H. H. Truitt, of Purdue University; and Willard Warzyn, of the University of Wisconsin.

Of statistical interest was the fact that students from Kansas State College traveled the most man-miles to the conference; Illinois Institute of Technology was the best represented; and Purdue University was the best represented of the Chapters not in Chicago.

The Thursday evening smoker proved of great interest to the delegates, as did the various inspection trips. The places visited included the Chicago subway, the Museum of Science and Industry, the parks, Northwestern Technological Institute, Fort Sheridan, the Great Lakes Naval Training Station (where the members enjoyed "mess" with the sailors), the South Side Filtration Plant, the Southwest Side Sewage Treatment Plant, and various housing projects. The accompanying photograph of the group in the Chicago subway was taken by Vincent L. Rambo, representative of the Kansas State College Chapter.

News of Local Section

Scheduled Meetings

CENTRAL OHIO SECTION—Luncheon meeting at the Fort Hayes Hotel on January 15, at 12 m.

CLEVELAND SECTION—Annual dinner meeting at the Guildhall, on January 5, at 6:30 p.m.

DISTRICT OF COLUMBIA SECTION—Dinner meeting at the Washington Hotel on January 27.

METROPOLITAN SECTION—Technical meeting at the Engineering Societies Building on January 14, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Alcazar Hotel on January 8, at 7 p.m.

NORTHWESTERN SECTION—Dinner meeting of the Junior Chapter at Mrs. Bryan's Tea Room on January 20, at 6:30 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers' Club on January 13, at 6 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.; dinner meeting of the Junior Forum at Hart's Restaurant on January 14, at 6 p.m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on January 26, at 12:15 p.m.

SAN FRANCISCO SECTION—Dinner meeting of the Junior Forum at the Engineers' Club on January 22, at 5:30 p.m.

SOUTH CAROLINA SECTION—Annual winter meeting at the Columbia Hotel, Columbia, on January 9, at 11 a.m.

TACOMA SECTION—Dinner meeting at the Lakewood Community Center on January 10, at 6:30 p.m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the S. & W. Cafeteria on January 13, at 5:45 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Dallas Athletic Club on January 5, at 12:10 p.m.

WYOMING SECTION—Dinner meeting at the Frontier Hotel, Cheyenne, on January 22, at 6:30 p.m.

Recent Activities

ARIZONA SECTION

A number of timely papers were scheduled for the technical program presented at the annual meeting of the Section, which was held in Phoenix on November 22. The list of speakers included John G. Girand, engineer with Lescher and Mahoney, whose subject was "The Phoenix Low-Cost Housing Project"; Phil Dickinson, Regional Director of Information for the U. S. Bureau of Reclamation, who discussed the construction of Friant Dam and its function in the Central Valley Project; and George D. Whittle, senior highway bridge engineer for the Public Roads Administration at San Francisco, who spoke on the Tacoma Narrows Bridge disaster. At noon there was a joint luncheon with the Phoenix Chapter of the Arizona Association of Engineers, the guest of honor and speaker being W. D. La Due, chief engineer of the Goodyear Tire and Rubber Company. Mr. La Due described features of construction and plans for operation of the airplane parts factory now under construction near Litchfield Park, Ariz. A cocktail hour, with Vic H. Housholder acting as host, preceded the banquet. Moving pictures of Arizona, shown by Floyd R. Getsinger, and social dancing concluded the evening. During the annual business session the following officers were elected for the coming year: John H. Gardiner, president; John A. Carollo, first vice-president; L. O. Foscel, second vice-president; and W. G. O'Harra, secretary-treasurer.

Central Illinois Section

A dinner meeting, sponsored jointly by the Capitol Chapter of the Illinois Society of Engineers and the Central Illinois Section of the Society, was held in Springfield on November 18. Following dinner, the Illinois Association of Highway Engineers and the Springfield Engineers Club joined the group to hear Col. Edward Davis speak on the subject, "Experiences of a Military Attaché." Colonel Davis, who is a retired army officer and state purchasing agent, described many interesting experiences during the World War in such places as Jerusalem, Turkey, and Australia. His talk was illustrated with slides and motion pictures.

Cleveland Section

Civilian protection during aerial bombardment was discussed by Harold E. Wessman at a meeting held on October 6. Dr. Wessman, who is chairman of the civil engineering department at New York University as well as chairman of the Metropolitan Section's Committee on Civilian Protection in War Time, presented factual data on different types of bombs and discussed tests under way in the United States to obtain empirical data for design purposes. He also commented on the Society's role in coöperating with the government on local defense issues. Dr. Wessman illustrated his talk with slides showing damage done to different types of structures in China and London as the result of aerial bombardment.

On November 3 the speaker was Lt. Col. D. Lee Hooper, district engineer for the U.S. Corps of Engineers at Pittsburgh, Pa. After some general comments on the work of the Corps of Engineers, Colonel Hooper described the functioning of this group in the construction of the Upper Ohio—Beaver River Basin Project, a series of multiple-purpose dams.

Iowa Section

On November 20 members of the Iowa Section met at Des Moines for afternoon and evening sessions. At the business meeting in the afternoon M. C. Miller was elected president, and E. W. Lane, vice-president. L. O. Stewart continues as secretary. Following a dinner in the evening, Lt. C. C. McNamara, assistant engineer for the U.S. Bureau of Reclamation, outlined the organization of the Des Moines Ordnance Plant. The other speaker was E. E. Howard, Director of the Society, who discussed the activities of the Board of Direction and the role of the United States in the present world situation. "The United States must not be made to choose between butter and guns during the national emergency . . . . " he stated. "While the major portion of the nation's productive output should be devoted to defense guns, sufficient butter—civilian work for civilian purposes—should be allowed to keep the country's economic condition half way normal."

Kansas City Section

An inspection tour of the Lake City Ordnance Plant at Independence, Mo., comprised part of the program of a meeting of the Kansas City Section held on October 21. Members and their guests were conducted about the plant by Capt. Leslie R. King, of the Quartermaster Corps, U.S. Army. In the Ballistics Building, the Remington Arms Company official in charge explained and demonstrated various tests, while C. A. Haskins, sanitary engineer for Smith Hinchman and Grylls, Inc. (architect-engineer for the plant), conducted the group through the water-purification plant. Following a dinner in the evening, many points of interest concerning the plant and the manufacture of ammunition were brought out. The speakers were Lt. Col. W. J. Crowe and Capt. L. C. Barnes—respectively commanding officer and constructing quartermaster for the Lake City Ordnance Plant—and Captain King.

Metropolitan Section

"The Use of Models in Engineering Planning" was the subject of a symposium presented at the November 19th meeting of the Section. The principal speaker was Theron D. Galloway, structural engineer for the Consolidated Edison Company of New York, who discussed the use of a scale model in planning successive steps involved in the demolition of existing facilities and the construction of new coal and ash-handling facilities at the waterside stations of the company while maintaining the plant in full operation. The various stages of construction were illustrated by lantern slides and demonstrated on the model in a most effective manner. The work under discussion was designed to permit the construction of East River Drive along the waterfront, and the lack of working space necessitated the most detailed planning which was facilitated by the model. Then Charles A. McCollough, construction supervisor for the J. G. White Engineering Corporation, discussed the field operations, and Lester C. Hammond, chief engineer for the Borough of Manhattan, described the construction of the East River Drive in relation to the "revamping" of the Edison Plants.

Mid-South Section

Members and guests of the Mid-South Section were in Vicksburg, Miss., on October 31 and November 1 for the annual meeting of the Section. The Friday technical sessions included talks by George E. Bertram, of the Office of the Chief of Engineers, U.S. Army, whose subject was "Use of Field Bearing Tests in Airport Runway Design"; Theodore R. Kendall, editor of *Contractors and Engineers Monthly;* and Brig. Gen. Max C. Tyler, president of the Mississippi River Commission. At noon there was a joint luncheon with the Vicksburg Engineers' Club, which was attended by General Tyler, E. B. Black, (nominee for President of the Society), and other distinguished guests. The principal speaker was James E. Jagger, Field Secretary of the Society, who discussed the aims and activities of the Society. The evening was enlivened by a banquet and dance at the Vicksburg Country Club. Frank V. Ragsdale was toastmaster, and F. B. Wood, chairman of the program of entertainment. The principal address, entitled "Riding the Waves," was given by Bennett Chapple, assistant to the president of the American Rolling Mills Company.

On Saturday morning there were business and technical sessions. The program for the latter consisted of talks by George S. Covert, Jr., district engineer for the Mississippi State Highway Commission, who discussed present practices in the construction of asphalt roads; Frederick W. Cron, assistant highway engineer for the Public Roads Administration, whose subject was "Soil Stabilization on the Natchez Tract Parkway"; and Capt. Kenneth E. Fields, director of the U.S. Waterways Experiment Station, who outlined plans for a forthcoming inspection trip to the Station. During the business session new officers were elected as follows: Norman R. Moore, president; Robert J. Woods, Jr., vice-president; and Spencer J. Buchanan, secretary-treasurer. In the afternoon there was an inspection trip to the Experiment Station, which concluded the meeting. Special entertainment for the ladies included a bridge luncheon and tour of the city.

Northwestern Section

At the annual business meeting, held in St. Paul, Minn., on December 1, the following officers were elected for the coming year: George J. Schroepfer, president; George M. Shepard, first vice-president; Paul R. Speer, second vice-president; and Frank S. Altman, secretary-treasurer. Life Member Murray Blanchard then discussed the activities and accomplishments of Frederic Bass, newly elected Life Member.

On November 10 the Junior Chapter sponsored a program of talks by H. C. Timberlake, manager of Defense Contract Service, and Charles R. Butler, assistant manager of Priorities Field Service. The latter discussed priorities, while Mr. Timberlake spoke on defense contracts.

Oregon Section

The general theme of the program, presented in Portland on November 13, was the new Chemical Products Plant of the Portland Gas and Coke Company. George W. Gleeson, head of the chemical engineering department at Oregon State College, discussed the general chemical aspects of the new plant. He was followed by Clyde Wright, engineer with the Portland Gas and Coke Company, who described the details of construction, illustrating his talk with colored motion pictures.

Panama Section

The Panama Section reports that, at the September meeting, a symposium on the Third Locks Construction was presented by Lt. Col. Hans Kramer, assistant supervising engineer of the Panama Canal; E. B. Fontaine, area engineer of the Atlantic Area; J. W. Sibert, area engineer of the Pacific Area; and R. P. Johnson, senior concrete engineer. Colonel Kramer outlined the general program of construction for the project and described the work to be accomplished by contract and that to be done by hired labor. Mr. Fontaine pointed out the principal items of work in the Atlantic

Area, which to date have involved dry excavation, dredging, and relocations, using slides to illustrate the progress of lock excavation, railroad relocation, and highway construction. Mr. Sibert described the features of work assigned to the Pacific Area, while Mr. Johnson presented a general picture of the concrete requirements of the project.

New officers for the Section—elected on December 1—are James G. Steese, president; Edward M. Browder, Jr., first vice-president; Thomas J. Rentenbach, second vice-president; and Forrest L. Dye, secretary-treasurer.

SACRAMENTO SECTION

On December 9 the members of the Sacramento Section, by unanimous vote, adopted a resolution submitted for its consideration by a special committee. Condemning the "treacherous and unprovoked attack by Japan upon the territory of the United States on December 7, 1941," the resolution expresses "approbation of the action taken by our Government and unqualifiedly pledges its "individual and collective support and services to our Government at any time, place, or manner in waging this war to a successful conclusion. . . " It was further resolved that copies of the resolution "be forwarded to the President of the United States, the Governor of the State of California, and Civil Defense agencies."

SAN DIEGO SECTION

On November 28 Col. W. W. Crosby was honored by the San Diego Section in recognition of his receiving a certificate of life membership in the Society. In presenting the certificate to Colonel Crosby, President Capwell stated that it was the first time the Section has had the opportunity to present such a certificate to one of its members. Colonel Crosby then reminisced interestingly concerning his engineering experiences in this and other countries. He stated that his father, an engineer, took him to see Brooklyn Bridge soon after it was completed, and this structure so impressed him that he decided to follow an engineering career.

SEATTLE SECTION

"Ground-Water Resources and Development" was the topic of discussion at the November meeting of the Section. Arthur M. Piper, senior geologist in charge of the U.S. Geological Survey ground-water investigations in the Pacific Northwest, discussed the subject of ground-water resources and the effects of various types and sizes of soil particles on underground water storage and yield. He was followed by A. H. Tessier, Northwest manager of International Water Supply Ltd., who discussed actual methods of well drilling for consolidated and unconsolidated deposits. Slides of these methods were shown along with moving pictures of actual well developments in South America, Europe, Asia, and Africa.

TACOMA SECTION

At a meeting of the Tacoma Section, held on November 25, Allen S. Cary spoke on the subject of "The Application of Soil Mechanics to Mud Mountain Dam." Mr. Cary, who is assistant geologist in the Soils and Geology Division of the U.S. Engineer Office at Seattle, explained the principles of testing equipment developed at Mud Mountain Dam for checking the permeability, moisture content, and density of earth-fill materials.

TEXAS SECTION

A meeting of the Lower Rio Grande Branch of the Texas Section, held at Harlingen, Tex., on November 26, attracted a large number of engineers. Speakers included J. H. Selleck, hydrographer for the International Boundary Commission; and W. W. Hall and J. L. Lytel, respectively division engineer and project engineer of the Lower Rio Grande Control Project. Mr. Selleck presented a comprehensive discussion of stream-flow measurement of the Rio Grande from Laredo to the Gulf of Mexico, while Mr. Hall reviewed the economic possibilities of the Denison Dam Project, with reference to benefits of flood protection and anticipated revenues from sale of power. A description of the rapid tempo of defense activities in the Northwest was given by Mr. Lytel, who has recently returned from a visit to that part of the country.

TOLEDO SECTION

On October 20 George T. Seabury, Secretary of the Society, spoke on the subject of Society affairs and commented on labor unions in their relationship to the engineering profession. The technical program at the November 17th dinner meeting consisted of a talk on "Porcelain Enamel," given by Earl Smith, president of the Toledo Porcelain Enamel Products Company. Mr. Smith traced the early history of porcelain enamel, showing how it has been transformed into a modern material of construction.

VIRGINIA SECTION

The fall meeting of the Virginia Section took the form of a two-day session held in Roanoke on November 7 and 8. At the technical session on Friday afternoon two student papers were presented—one on "Frost Heave," by L. A. Durham of the Virginia Military Institute Student Chaper, and one on "Engineering Education from a Student's Point of View," by W. F. Cline of the Virginia Polytechnic Institute Chapter. Henry Norton Stone, erection engineer for the Virginia Bridge Company, then described the construction of a steel bridge in Alabama, illustrating his remarks with colored motion pictures. The afternoon meeting was followed by a social hour and dinner, with F. B. Turner acting as toastmaster. The after-dinner speech was given by C. W. Hutchinson, assistant supervising engineer of the Radford Ordnance Works. The latter speech was preparation for the Saturday inspection trip to Radford. Worthy of note is the fact that the plant was constructed in a period of about a year and is now in full operation.

Student Chapter Notes

BROWN UNIVERSITY

The Brown University Student Chapter reports that several interesting meetings have been held this year. The Contact Member, Harold E. Miller, was usually present and advised on matters of organization. Student talks comprised the technical programs, the subjects ranging from "Bridge Construction" to the "Printing and Dyeing of Textiles." On one occasion a student from the Virgin Islands discussed water supply and sewage disposal problems in that part of the world.

RHODE ISLAND STATE COLLEGE

The Rhode Island State College Chapter is carrying out a busy schedule. During the fall there was a great deal of emphasis on field trips. The points of engineering interest visited included the Thames River Bridge at New London, Conn.; the plant of the American Bitumuls Company at East Providence, R.I.; and the Cranston (R.I.) Sewerage Works. In the accompanying photograph members of the Chapter are shown viewing the latter project. There was a large representation at the Annual Student Night at Massachusetts Institute of Technology. Regular meetings were devoted to a program of student papers and outside speakers, the latter including Philip D. Creer, head of the department of architecture of the Rhode Island School of Design, and C. W. Stewart, of the American Bitumuls Company.

RHODE ISLAND STATE COLLEGE CHAPTER AT THE CRANSTON SEWERAGE WORKS

Members of Syracuse University Student Chapter

Syracuse University

A sound motion picture of the construction and operation of the Pennsylvania Turnpike was shown through the courtesy of the Portland Cement Company at one of the meetings of the Syracuse Chapter. On other occasions the Society's illustrated lectures were enjoyed, the one on aerial photography proving especially popular. The members sat for a group photograph, which is reproduced herewith.

College of the City of New York

Weekly meetings have been enjoyed by the College of the City of New York Chapter during the past semester. Among the outside speakers addressing these gatherings were Frank H. Nowaczek assistant engineer for the New York City Board of Water Supply, who gave an illustrated lecture on the construction of the Delaware River Aqueduct; Charles W. Cunningham, Faculty Adviser for the Chapter, who discussed the advantages of belonging to the Society; George Hayden, office engineer for the Portland Cement Association; and James I. Ballard, managing editor of *Engineering News-Record*, who spoke on concreting methods used on the construction of Shasta Dam. Other sessions were devoted to business discussion and to the presentation of student papers.

Iowa State College

A "round-up picnic," held early in the school year, initiated Student Chapter activities at Iowa State College during the past semester. At one meeting F. C. Dana, professor of general engineering at Iowa State College, gave an illustrated lecture on Alaska, where he spent a recent vacation. At another, Capt. William F. Cassidy, head of the engineers' unit of the R.O.T.C. at Iowa State, showed talking motion pictures of methods used by the U.S. Army in bridging streams.

Rutgers University

Several interesting meetings have been held by the Rutgers Chapter during the past semester in spite of certain curtailments resulting from the national emergency. At one joint session with local groups of mechanical and electrical engineering students Morris Goodkind, Contact Member for the Chapter, discussed Society and Metropolitan Section affairs. Of particular interest to the group were his comments relative to the rise in rating of the Chapter. At another meeting "The Engineer as a Public Expert" was discussed by Willem Rudolfs, chief of the Department of Water and Sewage Research at the New Jersey Agricultural Experiment Station.

Newark College of Engineering

Among the speakers heard by the members of the Chapter at Newark College of Engineering during the past semester were Frank Butler, personnel manager of the Sperry Products, Hoboken, N.J., and Frank Busse, personnel manager of the Falstrom Company, Passaic, N.J., both of whom discussed "The Civil Engineer in Personnel Relations Work"; Allan R. Cullimore, president of the college, who spoke on "Civil Defense Training"; and John R. Downes, sanitary engineer, who spoke on sludge disposal problems.

University of Utah

The Student Chapter at the University of Utah announces that, on November 14, it was host to the Utah State Agricultural College at Logan, Utah. Following a dinner, Lester Blackner, of the Utah State Road Commission, spoke on defense highways in the state. A dance concluded the evening. The Chapter won second place with its float in the annual "Homecoming" festivities held at the university in the fall. The group responsible for the prize-winning display is shown at the right. Officers for the coming academic year are as follows: Joseph Brubaker, president; Dean S. Storrs, vice-president; Robert B. Barker, secretary; and Marne Mercer, treasurer.

Members of University of Utah Chapter Responsible for Prize-Winning Float

Front Row, Left to Right, Elwood Neff and George McKeller; and Rear Row, Wallace Brown, Joseph Brubaker, and Dean Storrs

ITEMS OF INTEREST

About Engineers and Engineering

Civil Engineering for February

Defense construction by both the Army and the Navy will be described in the February issue. Captain J. J. Manning, U.S.N., tells of the "Work of the Civil Engineer Corps, U.S. Navy," and Col. Edmond H. Leavey, U.S.A., outlines the field of the construction division of the Army Quartermaster Corps in his paper, "Building for Our Expanded Army." These articles are timely and follow logically after the paper on "The Engineer and Defense Construction," by General Somervell in this issue.

Increased power demands of defense industries, combined with lack of rainfall, have caused an acute power shortage in the Southeast section of the country. Therefore the paper by Harry Wiersema on the "Progress of the TVA Power Program" will be of general interest.

In other fields, G. E. Symons tells of the Bird Island Laboratory of the Buffalo Sewer Authority, and E. A. Burt describes the building of the Angeles Forest Highway across the rugged San Gabriel Mountains, north and west of Los Angeles. In addition, there will be papers on a variety of subjects, including several from Society meetings.

Training Course for Municipal Engineers

Engineers and others interested in civilian defense are urged to enroll in a course on municipal bombardment protection, to be given in New York City from January 26 to February 7, 1942. The course, which is open to technically trained municipal employees who are graduates of accredited high schools, will include study of various types of bombs, the design of civilian shelters, public utilities, sanitary and health problems, and many other pertinent subjects. The course will include day and evening sessions.

Applications for enrolment and all inquiries concerning the courses should be addressed to Mr. John J. Furia, Director, Bureau of Training, New York City Civil Service Commission, 299 Broadway, New York City.

Books Requested for Men in Armed Service

Books by the million will change hands in the National Defense Book Campaign, which is to start January 12, 1942, and continue several weeks. During this period it is hoped that readers throughout the country will share the books they have enjoyed with our soldiers, sailors, and marines. The campaign, which is sponsored by the American Library Association, the American Red Cross, and the United Service Organization, seeks ten million books for U.S.O. houses, Army "dayrooms," ships, naval bases, and so on. Books should be taken to libraries, where they will be sorted, repaired if necessary, and sent on as quickly as possible to the places where they are needed. In many communities schools and other conveniently located places will be designated as collection centers.

Although the government provides libraries in the larger camps, the smaller units have no library at all, and even in most camps where libraries do exist, the demand for recreational reading is usually far greater than the supply. Books provided through the campaign will thus supplement the government's existing library facilities. Men on leave—and in "off hours"—depend on the dayroom of their company and their U.S.O. house for their leisure-time reading. There is a special demand for up-to-date technical material as well as for books on current affairs and plenty of good fiction.

Prof. N. G. Neare's Column

Conducted by

R. Robinson Rowe, M. Am. Soc. C.E.

War was the only topic of conversation during the dinner session of the January meeting of our Engineers Club. Many were in uniform, marking them as authoritative targets for fusillades of questions. At last Professor Neare dared interrupt.

"In November," he recalled, "Guest Professor Pickworth left Hi Flire heading his plane for home with a jammed rudder. Did anyone plot his course and compute his running time? 'Pick' is here to settle any arguments."

"Easy!" ventured Joe Kerr. "He had made a complete circle counterclockwise in two minutes and was again 4 diameters from his base. So he continued that way for one more minute, flipped over and flew clockwise a minute, flipped again at end of 5th minute and was home in 6 minutes flat."

"'Flat' is right," replied Pickworth. "Here's a sketch of that course with a detail of the 3-point landing—on one pate and two ears. No, Joe, that won't do, because I asked for the time his wheels touched the ground. But you are right that Hi can flip without his rudder."

"In that case," put in Cal Klater, "he could flip at the end of the 6th minute, fly another complete circle and land happy in 8 minutes."

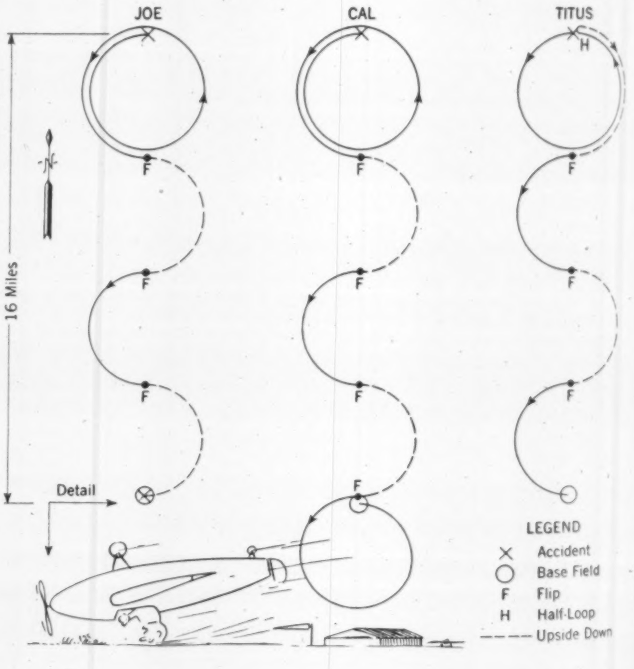
"That does it," agreed Pickworth.

"But it would have wasted gas," exclaimed Titus Wadhouse. "I saw the whole thing with a stop watch in my hand. At the second minute, Hi half-looped and flew clockwise head down. Flipping after 3rd, 4th, and 5th minutes, he landed head up in 6 minutes. I'll sketch it for you."

"Smart lad," applauded Professor Pickworth. "And I hear he has carved 11 notches on his joystick since landing in Manila. Both answers are right, tho. I didn't specify the quickest flight, but one which could be plotted in two minutes. Any comment, Noah?"

"Only to add that you are a diplomat, Pick. Two correct answers make everybody happy and proud except Joe. And he just whispered to me that his answer could be right if Hi was flying head down when his rudder jammed, which wasn't denied.

"Our next problem is a card table trick in mental arithmetic; draw a figure if you like. The card table is a real Grand Rapids product, with inflexible top and 4 sound legs of equal length—not the Nipponese imitation with infinite sidesway. If certain weights are set at two corners of the table, the 4 leg reactions are 1, 2, 3, and 4 lb. What is the weight of the table?"



[The several Cal Klaters were first-nighter Dean F. Peterson, Jr., Kenneth N. Phillips (who claims to have laid out the curved runway), and Byron A. Bledsoe. The Titus Wadhouses were two first-nighters, Benjamin Eisner and Roland Vokac, followed shortly by Sergt. I. M. Wunfootongroundski (Major Ray Adams, C.A.C.). The Joe Kerrs remain anonymous—in the hospital or worse. The basic idea for the card table problem was contributed by Puzzler Ralph W. Stewart.]

Prize Competition Announced by Arc Welding Foundation

Engineers and others may well be reminded of the current $200,000 Award Program of the James F. Lincoln Arc Welding Foundation. In the previous competition a number of Society members received generous prizes of money.

One does not need to be a "welding expert" to share in the 458 awards, as the program admits studies of design, manufacture, fabrication, construction, welding service, and maintenance in every field of industry. For instance, a design for arc-welded construction and a description of the design will constitute an eligible paper.

Those desiring further details should write at once to the James F. Lincoln Arc Welding Foundation, P.O. Box 5728, Cleveland, Ohio.

Alfred Noble Prize Awarded

This year the Alfred Noble Prize will go to Robert F. Hays, Jr., a member of the American Institute of Electrical Engineers. An item on this award will appear in the February issue.

NEWS OF ENGINEERS

Personal Items About Society Members

Additional changes in the status of members of the Society in the U.S. Naval Reserve and in the Officers Reserve Corps of the Army include Lt. Commander Herbert O. Lord, from chief engineer for the Madison (Wis.) Metropolitan Sewerage District to the 12th Naval District at San Francisco, Calif.; and Maj. Dugald C. Jackson, Jr., from dean of the college of engineering at the University of Notre Dame, to Executive Officer, Instrument Department, Frankford Arsenal, Philadelphia, Pa.

C. Milo Thelin, since 1928 designing engineer for the City of Fort Worth, Tex., was recently promoted to the position of assistant city engineer.

Michael J. Madigan, New York City consultant, and Edmund A. Prentis, secretary and treasurer of Spencer, White and Prentis, Inc., have been selected as recipients of the 1942 Moles Achievement Award for their outstanding achievements in the field of heavy construction. Formal awards in the shape of a bronze plaque and engraved certificate will be given Messrs. Madigan and Prentis at a dinner preceding the annual business meeting of the Moles held in New York City, on February 4.

Edmonde B. Kelly, captain, Corps of Engineers, U.S. Army, has been transferred from the U.S. Engineer Office at St. Paul, Minn., to the Office of the Chief of Engineers, U.S. Army, in Washington, D.C.

James A. Westbrook is on leave of absence from his position as sanitary engineer for the Orange-Person-Chatham Health Department, with headquarters at Chapel Hill, N.C., in order to serve in a similar capacity in connection with the construction of the Cherry Point Marine base near New Bern, N.C.

George O. Sanford has retired after many years in the U.S. Bureau of Reclamation. Since 1930 he has been in the Washington (D.C.) office of the Bureau, where he was general supervisor of operation and maintenance. Mr. Sanford will live in Marshfield, Mass.

Don M. Corbett, who is on the staff of the U.S. Geological Survey, has been transferred from Chattanooga, Tenn., to Indianapolis, Ind., where he will serve as district engineer in charge of surface-water investigations for Indiana and Michigan. Other changes in the Survey include the transfer of Harlan M. Erskine from Pittsburgh, Pa., where he was in charge of the sub-office, to the Charleston (W.Va.) district. Mr. Erskine will be in charge of making surface-water investigations for the state of West Virginia.

Frank E. Walter has been appointed chief engineer of the Inter-County River Improvement Commission, with headquarters at Sumner, Wash. He was formerly district manager for the WPA at Tacoma, Wash.

Paul N. Gillett, until recently structural engineer in the Corps of Engineers, U.S. Army, has accepted a position in a similar capacity with Smith, Hinchman and Grylls, Detroit (Mich.) architectural and engineering firm.

A. P. Hancock is now city manager of Amarillo, Tex. He previously acted in a similar capacity for the Texas municipalities of Kerrville and Crystal City.

Russell Charles Brinker, formerly assistant professor of structural engineering at the University of Minnesota, is now in the office of the Officer in Charge of Construction of the Naval Air Station at Quonset Point, R.I.

William M. Piatt, consulting engineer of Durham, N.C., has been appointed to the National Panel of Arbitrators of the American Arbitration Association, which has for its purpose expediting the settlement of commercial or industrial disputes that might delay national defense contracts.

Benjamin A. Whisler has been granted a year's leave of absence from his position as assistant professor of civil engineering at Iowa State College in order to serve as chief engineer of design and construction for the U.S. Corps of Engineers on the building of a new army training camp at West Yellowstone, Mont. Loren R. Heiple, formerly with the International Filter Company, of Chicago, Ill., will take Mr. Whisler's place at Iowa State.

Norman H. Hall has resigned as assistant chief engineer of the Iowa Conservation Commission at Des Moines, Iowa, in order to become area planning engineer for the Public Work Reserve.

Herbert D. Fritz, former maintenance engineer for the Independent School District of Burlington (Iowa), has accepted a position as associate engineer in the offices of the 7th Zone Constructing Quartermaster at Omaha, Nebr.

John D. Mendenhall, engineer for the Bechtel-McCone-Parsons Corporation, has been transferred from the Los Angeles and San José, Calif., offices of the organization to Wilmington, Del.

Carlos D. Bullock recently resigned as engineer for the Federal Works Agency in Washington, D. C., to accept a position as structural engineer for the Portland Cement Association in the Philadelphia (Pa.) area.

David E. Donley, major, Corps of Engineers, U.S. Army, has been appointed executive officer for the Utah Ordnance Plant at Salt Lake City, Utah. Until lately he was administrative officer at the Denver (Colo.) Ordnance Plant.

Howard A. Schirmer has been promoted from the position of district engineer for the Alameda Works of the Bethlehem Steel Company at Alameda, Calif., to that of contracting manager for the company. He will be succeeded as district engineer by R. E. Gauthier.

Murray Sullivan has resigned as design and construction engineer on the Ogden (Utah) Air Depot in order to accept a position as assistant area planning engineer for the Utah Public Work Reserve.

Arthur S. Tuttle, New York City consultant, has been appointed director of the Public Work Reserve for New York City. Mr. Tuttle is Past-President and Honorary Member of the Society.

Brehon B. Somervell, brigadier-general, Corps of Engineers, U.S. Army, has been appointed Assistant Chief of Staff G-4, in Charge of Supply, Washington, D.C. General Somervell was formerly chief of the Construction Division of the Quartermaster Corps, Washington, D.C.

Charles F. Ruff, previously engineer for the Federal Power Commission, Washington, D.C., is now with the Caribbean Architect-Engineer, with headquarters in New York City.

Robert R. Philippe was recently transferred from the U.S. Engineer Office at Pittsburgh, Pa., to the Office of the Division Engineer of the Ohio River Division, Cincinnati, Ohio.

Jarvis J. Bain, colonel, Corps of Engineers, U.S. Army, has been assigned as district engineer for the Memphis District of the U.S. Engineer Office. Until lately he was stationed at Richmond, Va.

Edward M. Proctor, Toronto consultant, has been appointed Canadian representative to the U.S. Bureau of Industrial Conservation. He will act as liaison officer between the Bureau and the Canadian Ministry of Munitions and Supply.

DECEASED

William Allen Blakemore (M. '34) chief engineer of the Gulf Oil Corporation, Houston, Tex., was fatally stricken with a heart attack while attending a football game on November 8, 1941. He was 52. Mr. Blakemore had been connected with the Gulf Oil Corporation since 1915, having gone there in the capacity of engineer. Prior to that he had been with the Canadian Pacific Railway and the United Fruit Company—as railroad location engineer for the latter in Honduras. During the war he served with the A.E.F. as lieutenant of Engineers on railway location and construction in France.

William Tatem Collings, Jr. (M. '31) engineer for the Imperial Irrigation District, Imperial, Calif., died recently at the age of 53. Mr. Collings had been with the U.S. Bureau of Reclamation on the Rio Grande Project, and field engineer for the Strong and Robinson Syndicate, of Los Angeles. For some years he was with the Imperial Irrigation District, having served as research engineer on the construction of the All-American Canal and as assistant to the chief engineer. He had been on sick leave since 1938.

Edwin Clarence Eckel (Affiliate '01) since 1933 chief geologist for the Tennessee Valley Authority, Chattanooga, Tenn., died in Nashville, Tenn., on November 22, 1941. He was 66. Mr. Eckel was with the U.S. Geological Survey from 1902 to 1907 and, later, was president of the Dominion Cement Company. He had made cement mill valuations for the U.S. Treasury Department and iron ore investigations in both this country and Europe. During the war he served with the U.S. Engineers in France, with the rank of major

Orville Alva Faris (M. '29) since 1934 engineer-appraiser for the Federal Land Bank of Houston, Houston, Tex., died on June 15, 1941, at the age of 56. From 1906 to 1913 Mr. Faris was on irrigation projects in Idaho and Utah; from 1914 to 1919, chief engineer of the Twin Falls South Side Canal Company; from 1920 to 1922, in private practice at Boise, Idaho; and from 1923 to 1933, on cooperative irrigation investigations in Texas for the U.S. Department of Agriculture and the Texas Board of Water Engineers.

Loring Nelson Farnum (M. '07) retired civil engineer of New York City, died at New Rochelle, N.Y., on November 13, 1941. Mr. Farnum, who was 73, was with the J. G. White Engineering Company of New York from 1907 to 1930—part of the time as vice-president. Earlier in his career (1890 to 1907) he was engaged in a private engineering and contracting practice, his work including the building and management of sugar mills in the West Indies.

Thomas Fleming, Jr. (M. '17) member of the Board of Associates of the California Institute of Technology, died at his home in Pasadena, Calif., on December 2, 1941. He was 60. At one time Mr. Fleming was a member of the Pittsburgh (Pa.) firm of Chester and Fleming. Later (1919 to 1929) he was production manager and vice-president of the Oil Well Supply Company of Pittsburgh, and from 1929 until a few months ago was vice-president of the Fayette City Water Company and the Jamestown Water Company (both Pennsylvania public service corporations).

Manford W. Furr (M. '36) professor of civil engineering at Kansas State College, Manhattan, Kans., died there on November 16, 1941. He was 53. Professor Furr went to Kansas State College as an instructor in civil engineering in 1917, advancing to the rank of full professor in 1927. A specialist in highway engineering, he had done research work for the highway commissions of South Dakota and Kansas and for other organizations. He had served as president of the Kansas Section of the Society and, at the time of his death, was Faculty Adviser for the Kansas State College Student Chapter.

William Burr Gester (M. '10), consulting engineer for the Robert W. Hunt Company, of San Francisco, Calif., died at his home in Berkeley, Calif., on November 12, 1941, at the age of 87. Mr. Gester was for many years engaged in railroad work, having been connected with the Central Pacific, the Lake Shore and Michigan Southern, and other lines. From 1902 to 1926 he was Pacific Coast manager for the Robert W. Hunt Company, and from the latter year on consulting engineer.

Henry Frederick Juengst (M. '84) retired engineer of St. Joseph, Mo., died on January 12, 1941, though word of his death has just reached the Society. Mr. Juengst, who was 85, had spent most of his career in water works engineering. He designed and constructed water works and appurtenant structures for numerous cities in the South and Middle West and, for many years, was civil and sanitary engineer for the St. Joseph (Mo.) Water Company.

Joseph Grant Kelley (M. '14) consulting engineer of Portland, Ore., died on November 14, 1941, at the age of 77. Mr. Kelley had been with the U.S. Engineer Office, the U.S. Lighthouse Service, and at one time was superintendent of the Port of Portland. For many years a Portland consultant, Mr. Kelley was responsible for investigations, examinations, and reports on hydroelectric and water power sites in Oregon and Washington.

Walter Henry Meier (M. '26) chief civil engineer of the Department of Domestic Production of the Atlantic Refining Company, Dallas, Tex., died at Arlington, Tex., on November 15, 1941. Mr. Meier, who was 55, had been with the Atlantic Refining Company since 1920. Earlier in his career he was field engineer for the Pioneer Telephone and Telegraph Company of Oklahoma City, and office manager for the Empire Gas and Fuel Company, of Bartlesville, Okla. During the war he served, successively, as first lieutenant and captain with the 7th Engineers in France.

Lardner Vanuxem Morris (M. '05) died at Bristol, Pa., on November 16, 1941, at the age of 71. Mr. Morris was with the Long Island Railroad from 1902 until his retirement in 1933, serving as chief engineer from 1917 to 1926 and as consultant engineer from the latter year on. In addition to his other duties, he was valuation engineer for the railroad from 1914 until his retirement.

Homer Burdett Norton (M.'08) retired civil and mechanical engineer, died at his home at Palatine, Ill., on November 29, 1941. He was 73. Mr. Norton was chief engineer of the Elk Tanning Company, a subsidiary of the United States Leather Company, for 39 years. Earlier in his career he was in railroad construction, having been maintenance engineer for the Union Pacific, assistant engineer for the Lehigh Valley Railroad, and chief engineer of the Buffalo, Rochester and Pittsburgh Railway. After his retirement in 1932 he was engaged as a consulting engineer. For three years he served as engineer of Ridgway (Pa.) Borough, for which he had previously designed and constructed a water works and dam.

Allan Ernest Sedgwick (M. '32) geologist and consulting engineer, of Los Angeles, Calif., died in that city on November 16, 1941, at the age of 60. From 1918 to 1929 Mr. Sedgwick was on the engineering staff of the University of Southern California and, during the past two years, has been consulting engineer for the Imperial Valley Irrigation District. From 1918 on he was, also, chief engineer for the 7th Street (Los Angeles) Light and Power Company.

Henry Aldis Varney (M. '17) retired civil engineer, died at his home at Gilmanton, N.H., on April 10, 1941, though word of his death has just reached the Society. Mr. Varney, who was 70, was town engineer of Brookline, Mass., from 1915 until his retirement about a year ago.

Einar Weidemann (M. '27) engineer of bridges and buildings for the Pennsylvania Railroad, Chicago, Ill., died in that city on November 12, 1941. He was 64. Mr Weidemann became structural designer for the Pennsylvania Railroad in 1909 and resigned in 1916 in order to become associated with Joshua d'Eposito on the design and construction of the Chicago Union Station. Returning to the Pennsylvania as assistant engineer in 1926, he was named engineer of bridges and buildings in 1928.

Ronald Blair Wills (M. '37) Kansas State Highway Engineer, of Topeka, Kans., died in Kansas City, Mo., on October 31, 1941. Mr. Wills, who was 45, had been with the Kansas State Highway Commission since 1920, having served as assistant engineer, assistant maintenance engineer, manager of highway planning, and engineer of design. He was made state highway engineer in 1939.